TECHNOLOGY DEPARTMENT

TECHNOLOGY REVIEW

July 1949

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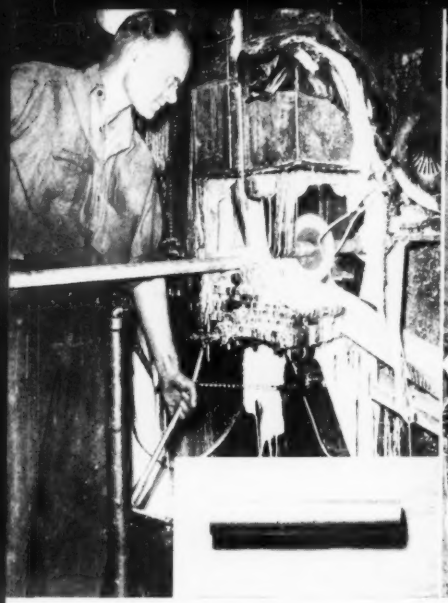
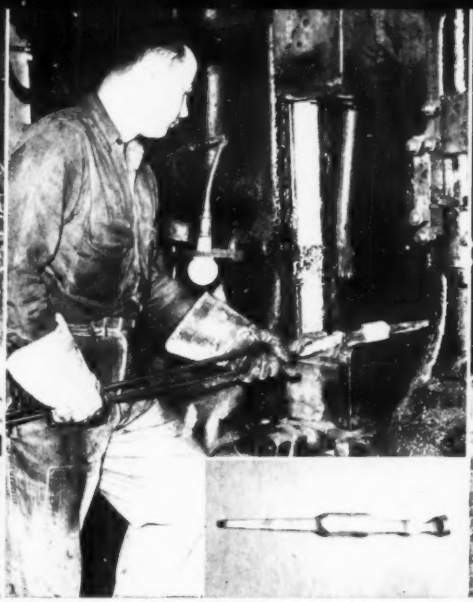
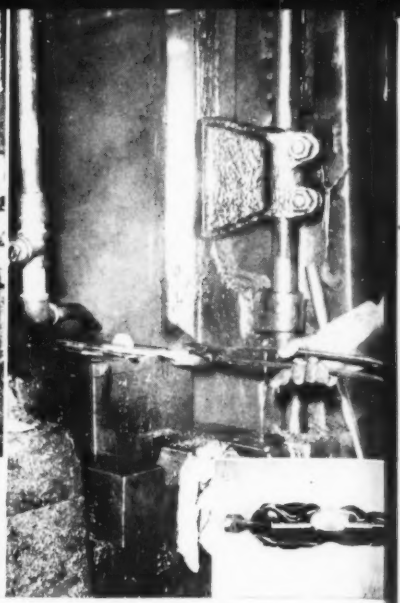


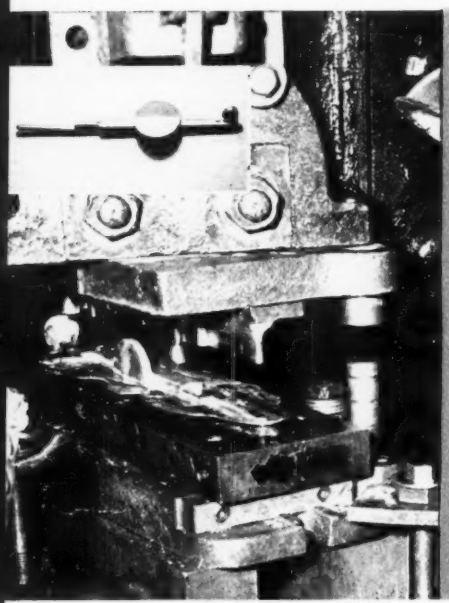
Cutting Bar



Lengthening and Shaping



Shaping to the Die



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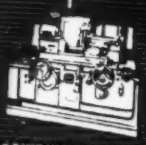

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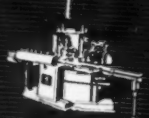

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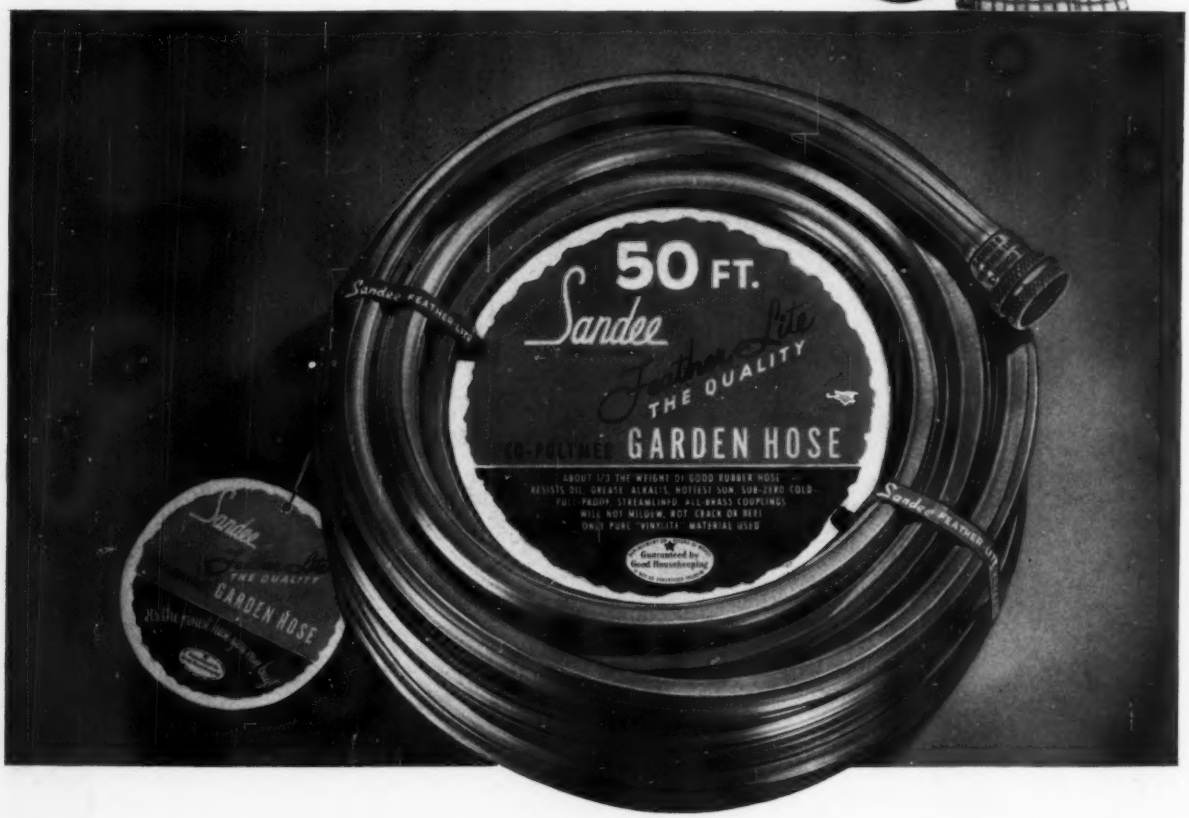

SPECTACULAR LIGHT WEIGHT . . small bulk . . ease of handling and storing . . these are outstanding features of SANDEE *Feather-Lite* Copolymer Garden Hose! In fact, it is about *one-third the weight of ordinary hose* yet gives full water volume. Here's the kind of gardening ease *and economy* you've long wanted. An extremely tough and *long lived* hose, that resists hottest sun, zero cold, greases, oils, alkalis. And, it won't mildew, rot, crack or peel! Fine brass couplings fit standard outlets and *won't pull off!* You can get it in 3 *permanent* colors . . Green, Red, Silver, with *structurally stronger* rib finish. SANDEE Garden Hose is nationally advertised, carries the Good Housekeeping Seal and a written guarantee. See it at your dealer's or write us.

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BLACK LIQUOR *is big business*

C-E Recovery Units save the Kraft paper industry millions of dollars annually by recovering chemicals from the spent liquor of the pulp-making process, and generating steam from the combustible ingredients of the liquor.

Not such strange bedfellows

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To those of you who associate the C-E trade mark with boilers — for industry, for public utility stations, or for ships — the apparently unrelated processes pictured above may seem to be strange bedfellows.

But to many the C-E flame means some special field of activity like one of those here illustrated, or such others as domestic water heaters, pressure vessels for the process industries, or the drying and incineration of sewage sludge.

The point is that all these seemingly diverse activities have a common kinship in Combustion's primary field — the efficient generation and use of heat. And all benefit by more than 60 years of experience in this field symbolized by the C-E flame.

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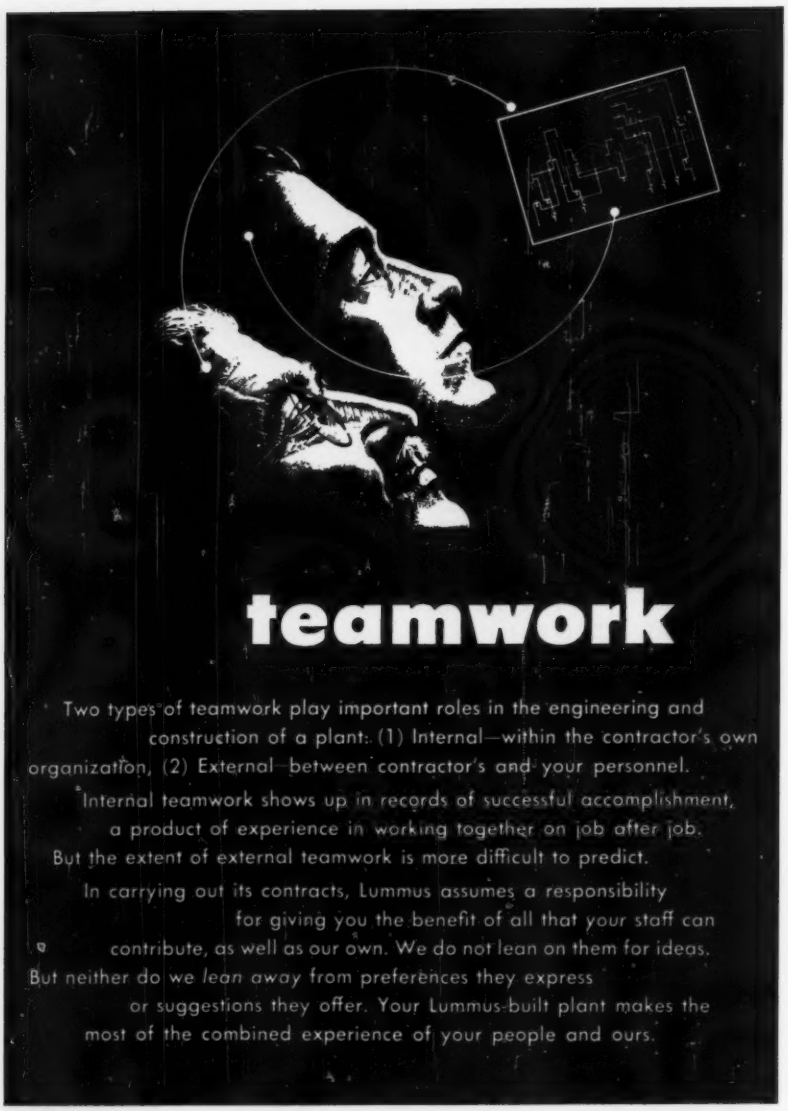

teamwork

Two types of teamwork play important roles in the engineering and construction of a plant: (1) Internal—within the contractor's own organization, (2) External—between contractor's and your personnel.

Internal teamwork shows up in records of successful accomplishment, a product of experience in working together on job after job. But the extent of external teamwork is more difficult to predict.

In carrying out its contracts, Lummus assumes a responsibility for giving you the benefit of all that your staff can contribute, as well as our own. We do not lean on them for ideas. But neither do we *lean away* from preferences they express or suggestions they offer. Your Lummus-built plant makes the most of the combined experience of your people and ours.

teamwork
in process development

In the development of improved methods of producing lubricating oil, Lummus has worked in close-knit cooperation with many leading oil companies. Lummus' exclusive pilot plant equipment for lube-oil process development has been employed to explore process alternatives suggested by these customers, supplementing their own research. More than 85 process units for solvent refining and dewaxing have resulted from this work—including the largest lube-oil plant in the world.

teamwork
in plant design

Lummus coordinated its engineering with the requirements and preferences of a leading chemical company—and laid the groundwork for an advanced type of ethylene plant. High yields are being obtained from a wide range of charge stocks. Operating costs are favorable, too.

teamwork
in plant construction

Construction in foreign countries and remote locations calls for a close relationship at the site between Lummus' personnel and oil company field forces. Assignment of men with a thorough knowledge of the region, its customs, laws and labor regulations, helps maintain this local cooperation. Records are maintained in accordance with client requirements for progress reports and cost control.

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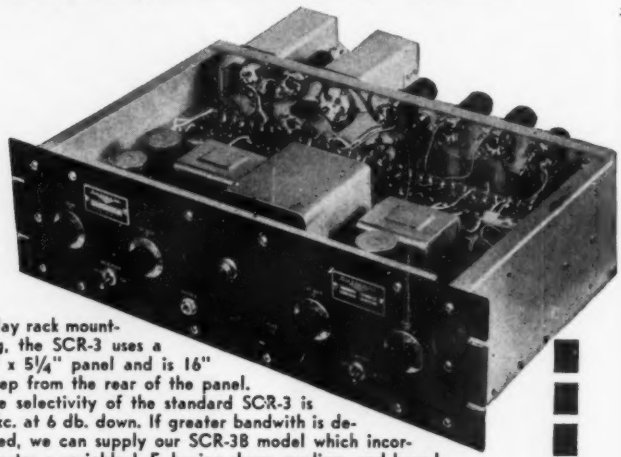
The National FSDR equipment has been designed to incorporate all the latest advances in automatic radio telegraphy. It is made expressly for use by communication companies, government services, shipping companies, airports, and others requiring the latest, most efficient equipment for receiving radio signals and converting them into electrical impulses which, in turn, key automatic terminal equipment. The National FSDR is now extensively used by the far-flung network of the Tropical Radio Telegraph Company and the Civil Aeronautics administration and similar departments of other countries. All report excellent results. The FSDR equipment consists of an FSR Receiver, FSL Limiter, and an FSK Keyer. Use of multiple FSRs and FSLs makes possible space diversity, frequency diversity, or both. Operation is extremely simple requiring only throwing of AC power switches. All units have a self-contained power supply designed to operate from 115 to 230 volts, 50/60 cycle supplies. Our engineers will be glad to recommend specific installations to suit your requirements.



SCR-3

SINGLE CHANNEL RECEIVER

The SCR-3 is a single-channel superheterodyne receiver with a self-contained power supply which may be operated from either 115 or 230 volts 50/60 cycle AC supplies. It is designed to operate on frequencies from 1.8 — 25 mcs. Two tuned R. F. stages insure a favorable signal-to-image ratio varying from approximately 55 db at 25 mc. to 90 db at 1800 kc. Pre-tuned R. F. circuits, a crystal-controlled oscillator, carrier operated noise suppression (C.O.N.S.), and automatic volume control allow the operator to devote his full time to message handling. For C. W. reception a special low-drift voltage regulated oscillator assures proper tuning over long periods of time. Designed for standard relay rack mounting, the SCR-3 uses a 19 x 5¼" panel and is 16" deep from the rear of the panel. The selectivity of the standard SCR-3 is 4 kc. at 6 db. down. If greater bandwith is desired, we can supply our SCR-3B model which incorporates a variable I. F. having sharp, medium, and broad positions ranging from 4 to 8 kc. at 6 db down. The crystal-controlled oscillator employs an oven-type or standard crystal dependent upon the severity of operating conditions. The SCR-3 Receiver is fungus-proofed to retard the harmful affects of humidity characteristic of tropical climate.

NAC

NATIONAL VHF RECEIVER

The NAC Receiver has been designed to satisfy the needs of airlines, small private airports, and other interests requiring a compact tunable VHF rack mounted receiver. The NAC is a superheterodyne, superregenerative receiver utilizing a self-contained speaker. The receiver can be used separately or as a converter with any conventional superheterodyne tuning to 10.7 mcs. This, in addition to offering increased sensitivity, makes all features of the associated receiver usable on VHF. The standard model covers frequencies from 112-153 mcs. However, coil ranges covering specific frequencies between 27 and 250 mcs. are available on special order. The NAC operates from a National SPU-5886 power supply which is designed for 115/230 volt, 50/60 cycle supplies. If portable operation is desired, either the National 686S vibrator power unit (6 volt) can be supplied or a standard 6-volt battery and B batteries supplying 135 to 180 volts may be used.

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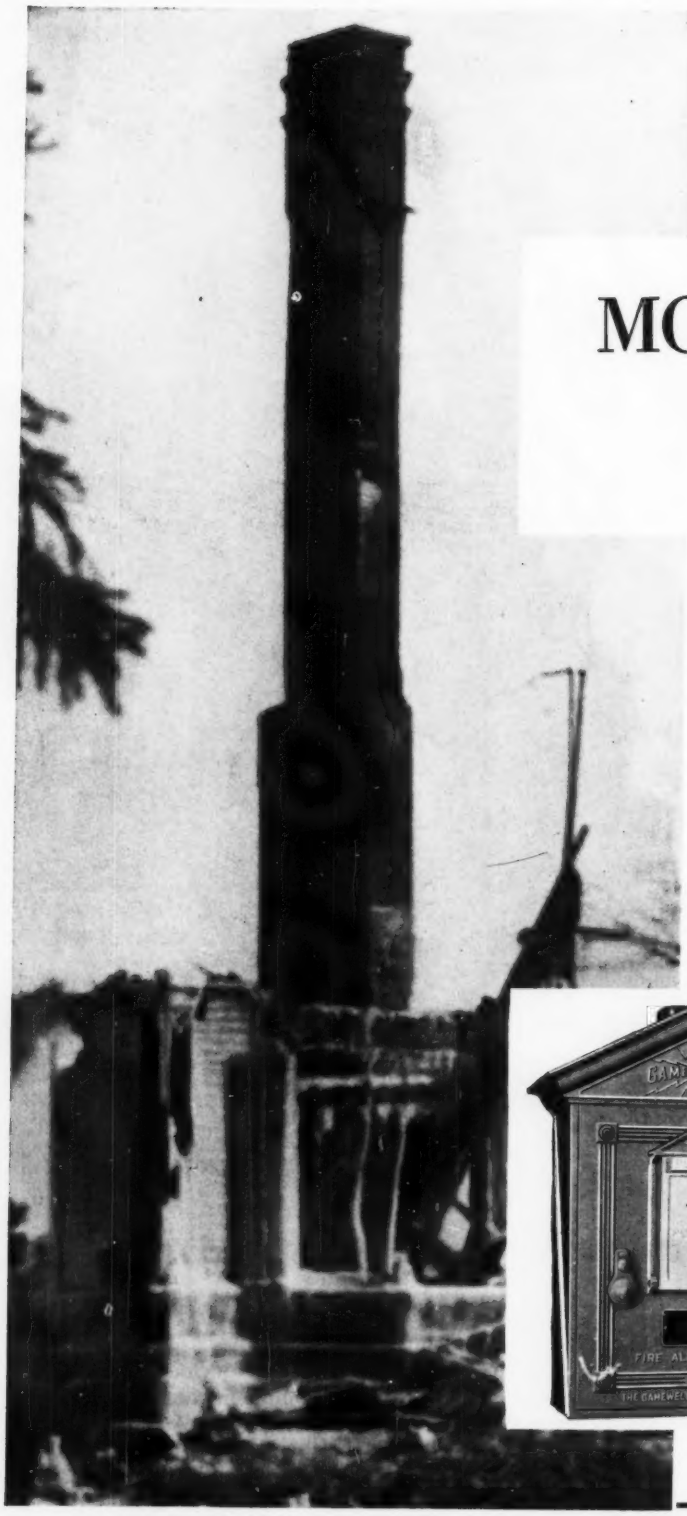

A MONUMENT TO NEGLECT

Fire Destroys Property

When property is destroyed by Fire, the community and everyone in it loses — Yet the community may protect itself against loss of wealth — and income — by keeping the fire losses low. There will always be fires — the problem is to extinguish them while they are small.

YOU Can Help

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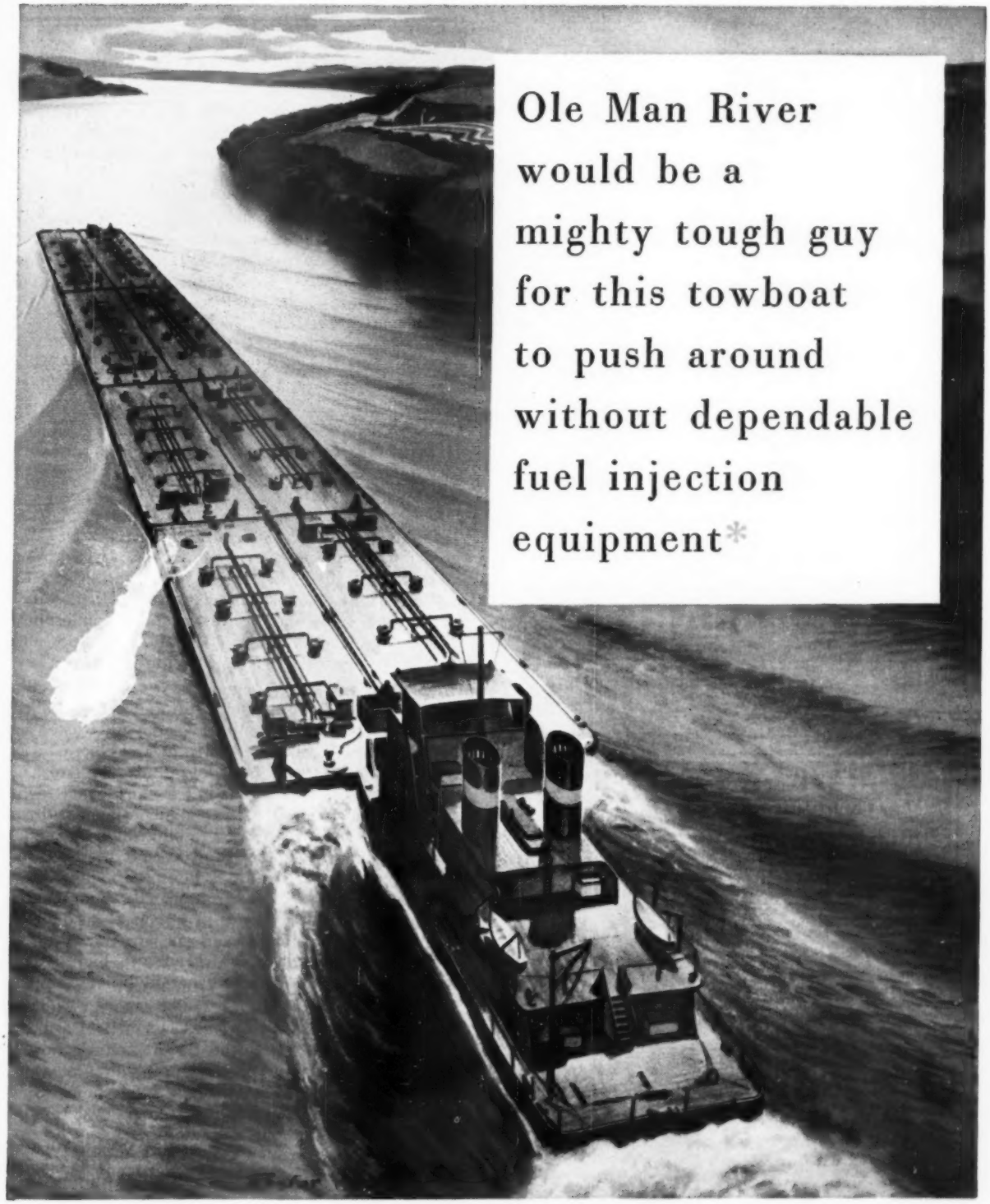

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THE TABULAR VIEW

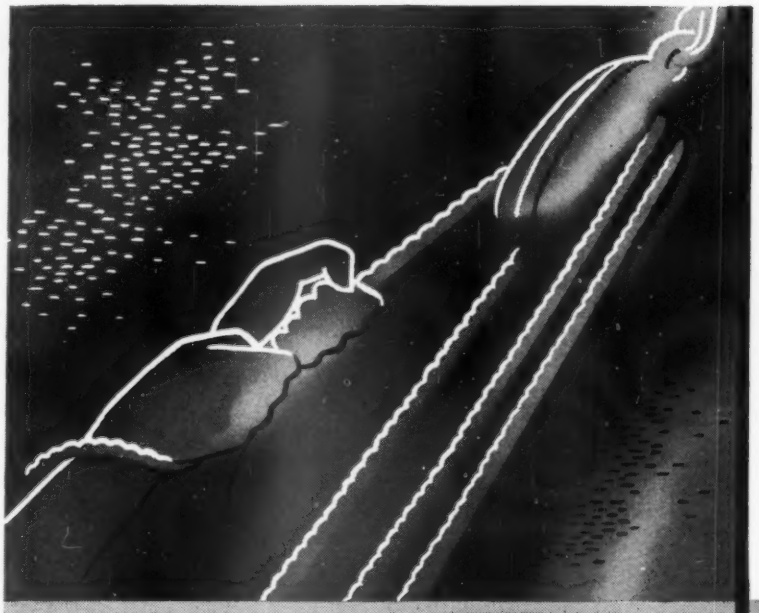
Engineering in 1876. — With Part I in the June issue laying the background for Part II by describing the national exuberance which characterized this nation at the time of the U.S. International Exposition of 1876, E. H. CAMERON, '13, concludes his article on the Centennial (page 557) by studying two exhibits, both of which superbly reflected the engineering achievements of their time. One is that of the Corps of Engineers of the U.S. Army; the other is the exhibit of the Massachusetts Institute of Technology. Mr. Cameron is head of the Technical Publications Division of Jackson and Moreland, and his studies of engineering progress in the post-Civil War period have appeared frequently in The Review.

River of Life. — The baccalaureate address to this year's graduates was delivered by the REVEREND CARL HEATH KOPF, well known to Bostonians as minister of the Mount Vernon Church in Boston and creator of the weekly program "From a Window on Beacon Street." Since last addressing the graduating class in 1945, Mr. Kopf has become minister of the First Congregational Church in Washington, D.C. His address, "This River Called Life," which appears on page 562, makes a strong plea for renunciation of the philosophy of "getting something for nothing" — a philosophy which is incidentally quite as invalid in politics and the social sciences as it is in the natural sciences.

Aristotle Today. — JAMES PHINNEY BAXTER, 3D, President of Williams College, historian for the Office of Scientific Research and Development, trustee of Radcliffe College, Phillips Academy, and other educational institutions, and, including in his distinguished career a brief detour as lecturer at the Lowell Institute, was selected to give the commencement address which The Review is pleased to publish on page 563. President Baxter is a strong advocate of the need for a truly broad and liberal education, although recognizing the need for specialization. His thoughts are emphasized by an amusing hypothetical account of the difficulties Aristotle would encounter were he to return to our present-day world with its high degree of specialization and lack of generally broad training.

Doing the Impossible. — PRESIDENT KILLIAN makes his initial bow before the Class of 1949, as head of M.I.T., in delivering the baccalaureate address "Doing the Impossible." It is The Review's pleasure to publish this significant address (page 567) which stresses a deep faith in a society free to develop independently, rather than the acceptance of governmental influences which may engulf individual advancement. As one of its former editors, The Review is proud to include Dr. Killian's address in this issue which concludes our present volume.

The Review is not published during the summer months following July. This issue, therefore, concludes Volume 51. Number 1 of Volume 52 will be published on October 27 and dated November. Readers who bind their copies are reminded that if they possess nine issues of Volume 51, their files are complete. An index to the volume will be ready on September 30 and will be supplied post free upon request.



When sail trimming is required

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MAIL RETURNS

Convocation Conversation

FROM THE RIGHT HONOURABLE WINSTON CHURCHILL:
Thank you so much for your letter and Technology Reviews which have given me interest and pleasure to receive.
Westerham, Kent, England

FROM HAROLD E. STASSEN:
Thank you very much for your kind letter of June 2 and for your kindness in sending me the extra copies of the May issue of The Review. I deeply appreciate your thoughtfulness and am very happy to have these extra copies.
Philadelphia, Pa.

FROM BERNARD M. BARUCH:
Thank you for your letter of June 1 and for the marked copy of the May issue of The Review. It was a great pleasure and honor to take part in the Convocation.
New York 22, N. Y.

FROM SENATOR RALPH E. FLANDERS:
Thank you for your letter of June 1 and for the May issue of The Review which you so kindly sent me.
Washington, D. C.

FROM NELSON A. ROCKEFELLER:
Thank you very much for your letter of the sixth and for your thoughtfulness in sending me the marked copy of The Review. The magazine will certainly serve as a memento of a most significant occasion.
New York 20, N. Y.

FROM ANDREY A. POTTER, '03:
Thank you for sending me a marked copy of The Review for May. My friends who read this copy felt that it was a splendid record of the contributions to the Mid-Century Convocation.
Lafayette, Ind.

FROM VANNEVAR BUSH, '16:
I thank you for your cordial letter of June 2. The May issue of The Review has reached me, and I regard it as a most interesting record of a distinguished affair.
Washington 5, D. C.

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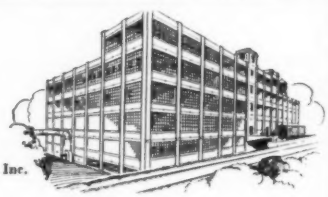

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* * *

Rare Gases Now Available in Quantity Offer Challenging Subject for Study

Among the least known of the elements have been the rare gases—Krypton and Xenon. Occurring in the atmosphere in concentration of one part per million for Krypton, and one part per twelve million for Xenon, their very scarcity gave them the status of "scientific curiosities" for a long time.

But now, these gases are available in quantity in refined, compressed form. As these gases assume the different role of "new" materials, their individual physical and electrical properties are finding interesting uses.

The increased efficiency of hot cathode (fluorescent) lights is a direct result of using Krypton as the gas filler. The brightest light ever made by man is produced by an electrical discharge through a column of Krypton . . . these lights are used to penetrate fog at airports.

Xenon is replacing mercury vapor in industrial (thyratron) tubes, to avoid low temperature condensation troubles. It is Xenon that makes practical the "repeater" (gas discharge) photographic flash lamp—the low resistance and good spectral range of the gas both being important. In the fast-growing field of atomic energy, the rare gases become increasingly important. The use of such gases in Geiger Mueller counter tubes is well familiar.

Chemists and physicists on many types of projects will want to study the possible value of these gases in their fields. Others may desire to work with the rare gases as such, contributing to further information in this expanding subject. Graduate students especially may find rare gases a fascinating, challenging, and wide open field for doctoral thesis.

In whatever connection, scientists who may want more information on Krypton, Xenon, Argon, etc., are invited to write us fully. Please write Dept. LAP, Room 1502, 30 East 42nd St., New York 17, N. Y.

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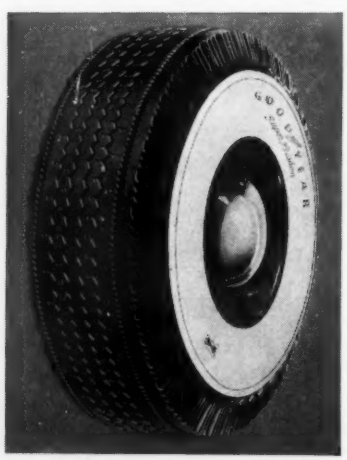

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11. More Car Economy!

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12. GREATER MILEAGE, TOO!

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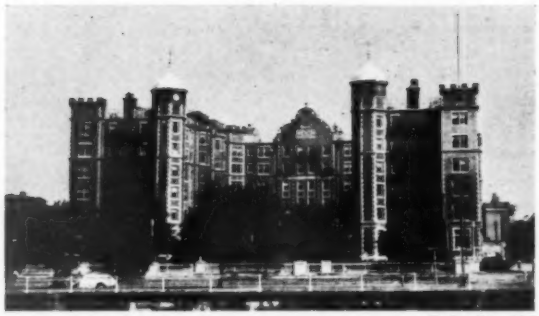
MORE PEOPLE RIDE ON GOODYEAR TIRES THAN ON ANY OTHER KIND



B. Dudley, '35

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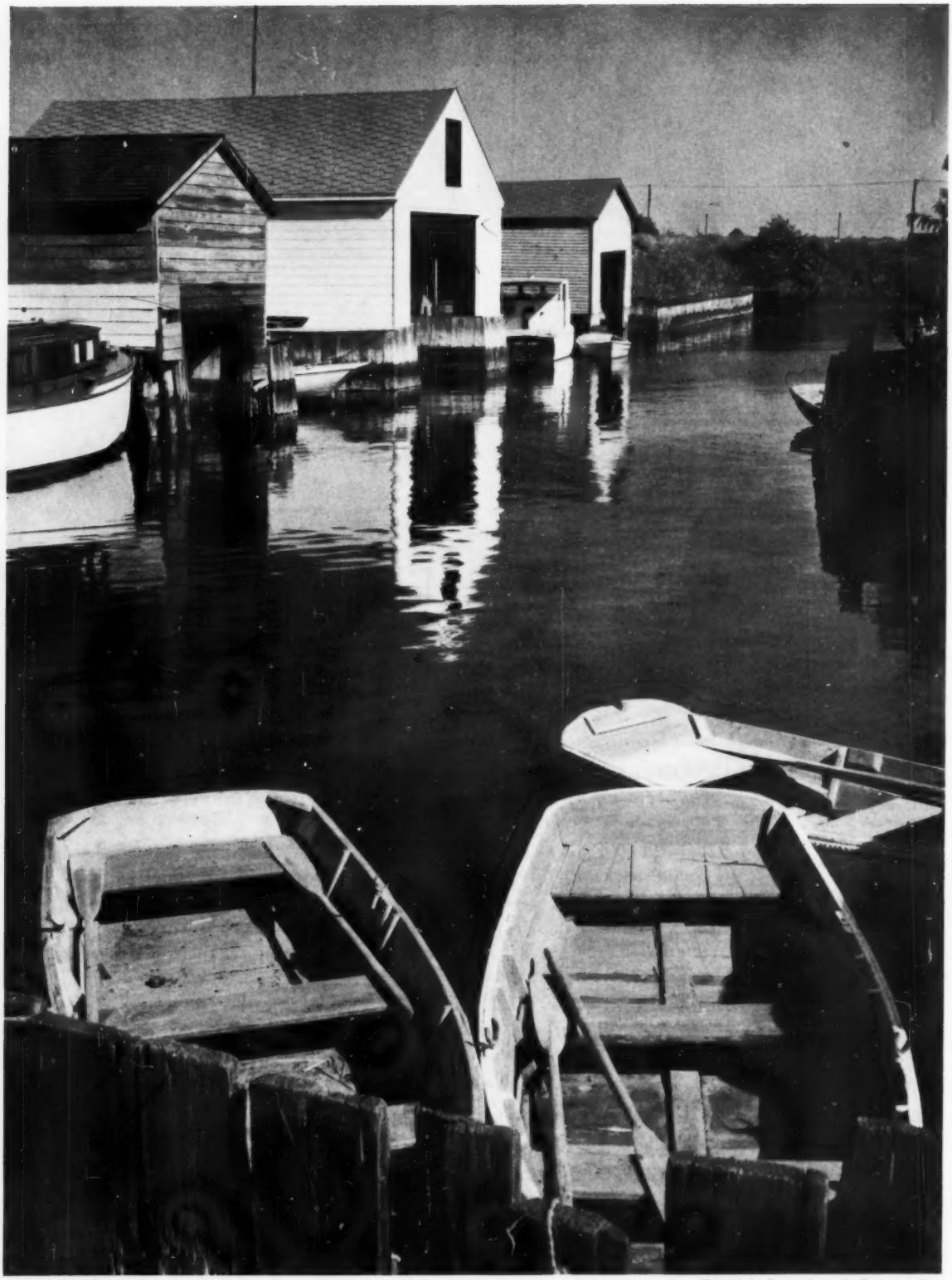


Gustav Anderson from A. Devaney, Inc.

Invitation to Relaxation

THE
TECHNOLOGY
REVIEW

Vol. 51, No. 9 July, 1949

The Trend of Affairs

First Rank

THAT the Institute continues its leadership in training men to assume foremost positions in the engineering field is once more strikingly illustrated in the article "College Antecedents of Successful Engineers" by D. B. Prentice which appeared in the May, 1949, issue of *Mechanical Engineering*. In a continuation of studies of the educational background of successful engineers, as represented by their listing in *Who's Who in Engineering*, Dr. Prentice supplements data given in earlier studies of the 1931 and 1937 editions by including a recent study of the 1948 edition of this well-known biographical reference work of leaders in the broad field of engineering.

The study is limited to graduates of colleges in the United States and Canada, and bachelor's degrees controlled the assignment of individuals to institutions of learning. In summarizing the results of the present study, Dr. Prentice says: "The Massachusetts Institute of Technology again heads the list in total alumni included, with Cornell second. Alumni of these two private, or endowed, colleges furnish one-eighth of all the engineers in the 1948 volume who were graduated from colleges in Canada and the United States."

The accompanying table, extracted from the article, includes only the 25 ranking listings according to the 1948 study. The comparative rank of educational institutions for the 1931 and 1937 studies has been added in The Review's listing, although this data does not appear in the table prepared by Dr. Prentice. It is perhaps significant that the comparative listings of the top-ranking institutions have not changed appreciably in almost two decades.

Other data in the *Mechanical Engineering* article show that of the 22,475 Alumni who have received bachelor's degrees from Technology, 933 are listed in the current edition of *Who's Who in Engineering*. Thus, 4.15 per cent of the Institute's graduates have become sufficiently outstanding in engineering to merit listing in this directory of prominent persons. Of the schools of engineering and technology, Rose Polytechnic Institute and Worcester Polytechnic Institute follow, in order, with more than 3.5 per cent of their Alumni listed among the men of distinction in engineering.

COLLEGE ALUMNI LISTED IN *WHO'S WHO IN ENGINEERING*

Name of Educational Institution	*Number of Alumni Listed*			*Rank*		
	1948	*1937*	*1931*	*1948*	*1937*	*1931*
M.I.T.	933	761	664	1	1	1
Cornell	667	611	562	2	2	2
Michigan	585	460	385	3	3	3
Illinois	450	364	295	4	4	4
Purdue	384	309	254	5	5	8
Wisconsin	357	305	269	6	6	6
California	299	229	207	7	10	9
Ohio State	299	254	192	7	9	11
Columbia	281	292	281	9	7	5
Yale	270	270	256	10	8	7
Minnesota	269	182	157	11	13	14
Harvard	234	200	190	12	11	12
Kansas	219	124	119	13	20	20
Pennsylvania	213	197	179	14	12	13
Iowa State	211	171	144	15	15	17
Rensselaer	194	125	120	16	19	19
Stanford	188	132	145	17	18	15
Penn State	181	147	110	18	16	21
Lehigh	174	175	201	19	14	10
Colorado	160	92	80	20	27	28
Washington	155	107	82	21	23	26
Worcester	155	147	145	21	16	15
Stevens	150	122	122	23	21	18
Case	135	105	85	24	24	25
Nebraska	132	111	93	25	22	23

Progress in Radiosondes

THE letters *AN-AMT-3* are not symbols representing an advertising slogan for a brand of cigarettes, but the Army's designation for a new type of radiosonde for meteorological work.

A radiosonde, as is well known even to most nonmeteorologists, is a compact set of three sensing instruments – one for temperature, one for air pressure, and one for humidity – which are connected with a small battery-powered radio transmitter in such a way that the readings of the instruments can be received and evaluated by a ground station. The radiosonde itself was preceded by two other types of instrument sets; in fact, it combines the desirable features of both of these two types.

The first of them was a balloon-borne aggregate, consisting of an aneroid capsule for measuring pressure, a bimetallic strip for measuring temperature, and a hair hygrometer for measuring relative humidity. Each of the three had its own recording mechanism which traced a line on an unrolling paper strip. Such balloon-borne sets had to be recovered in order to yield the information they had gathered. The rate of loss was high, and even if found, the information was valuable only for general meteorological research. It inevitably came too late to be useful for the intended work of weather forecasting.

The other type was the unmanned ground station. The readings of the instruments were transmitted electrically through a cable, and since the batteries could be located at the receiving end, the need for servicing of the station itself was kept at a minimum. The two methods of transmitting the information greatly influenced later developments. One was named after the Dutch instrument maker, Olland of Utrecht, who invented it in 1877. It can best be explained by referring to a modern clock of the type which has a so-called "sweep hand" for seconds, mounted on the same shaft as the other two hands. If the hour and minute hand indicate, for example, temperature and pressure, and if the sweep hand in passing them makes contact and sends a signal every time, an indication of their positions is easily transmitted. To make doubly sure that no mistake was made, Olland also placed a contact at the "12," thus providing a fixed reference signal. The other method had been invented at about the same time by the Italian, Professor Cerebotani. It worked with a drum made of hard rubber into which two contact strips of metal had been inserted, forming a *V*. A contact arm moved around the cylinder: if it was at the bottom, it sent only one signal; if at the very top, it sent two signals.

The problem was, or seemed to be, to combine either the Olland or the Cerebotani principle with the instruments of the balloon-borne set and to do the transmitting by radio. The first to find a workable solution appears to be Moltchanoff, but since he worked primarily for the German Zeppelinbau, his instrument is known under its German name of *Kammgerät* or "*comb apparatus*," derived from the comblike arrangement of the contact points.

During the years from 1923 to 1938 at least 20 different types of radiosondes were designed and tested; some of them were even manufactured in small quantities. The Olland principle was quickly abandoned because of the need for a very accurate, and therefore expensive, clockwork. The Cerabotani principle could be made to work even with a cheap clock because one could also transmit an indication of the revolutions of the drum which could serve to correct deviations of the clock. Especially the Frenchman, R. Bureau, had fine results with such a construction. The type developed by the Finnish scientist, Vilho Väisälä, was even superior, but since it transmitted the readings by deviations of the wavelength of the carrier wave, it could not be introduced in countries where wavelengths are strictly allocated.

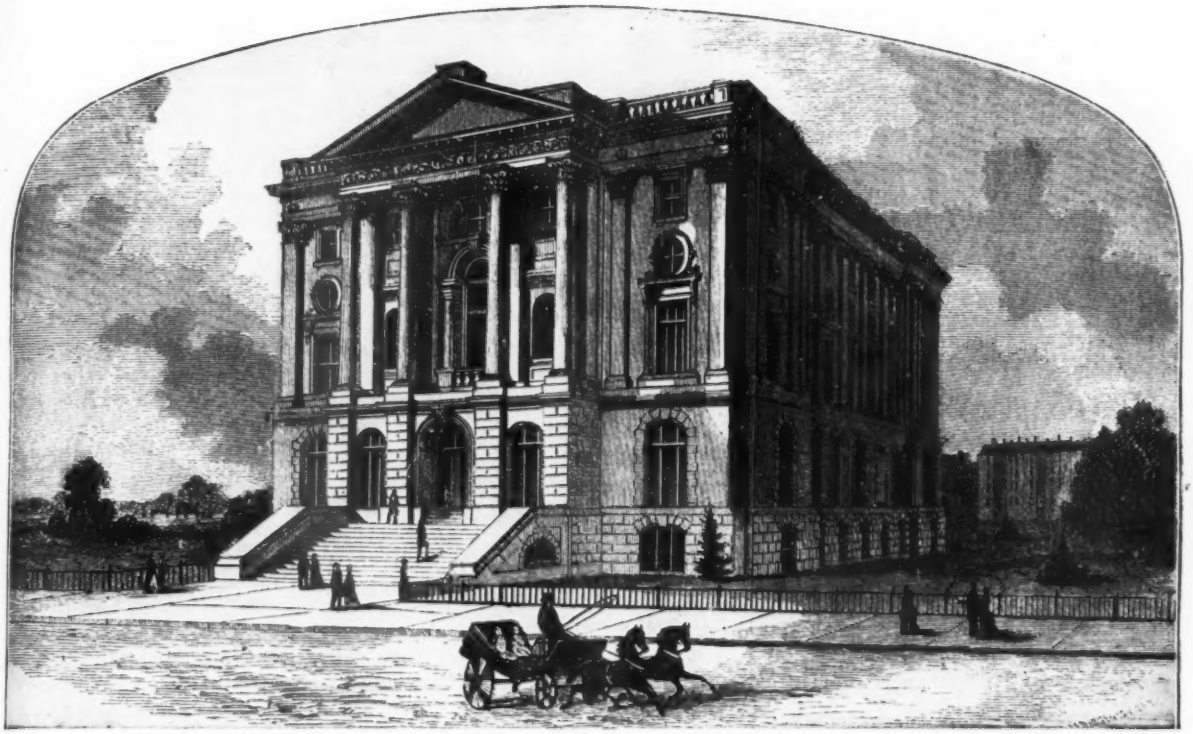
The United States adopted a type originally developed in the Bureau of Standards by Harry Diamond, '22,* Wilbur S. Hinman, Jr., and Francis W. Dunmore which transmitted the information over a modulated carrier wave. This type was put into service in 1938 at the Naval Air Station, Anacostia, D.C., during the following year in 12 weather stations, and one year later in 45 stations. Not only was the method of transmission novel, the device for measuring temperature was new, too. It was no longer a bimetallic strip but a fine-bore glass tube filled with an electrolyte which changed resistance with temperature. A few years later this electrolyte-filled glass tube was replaced in turn by a semiconductor of metal oxides which have characteristics similar to the electrolyte but are mechanically superior to the glass tube.

And in 1944 even the hair – "natural blond, unbleached, untreated with chemicals, at least 36 centimeters long" – had to give way to electrochemistry; it was replaced by an electrolyte-covered strip of transparent plastic. Except for the aneroid capsule which supplied the pressure reading, all measurements had become direct electrical measurements.

But in the *AN-AMT-3* everything is mechanical again! Human hair is used for the humidity element, the customary aneroid capsule for the pressure element, and a bimetallic strip for temperature. Each one produces mechanical movements which operate three pickup arms. The three arms all reach over to the code disk which looks like a very small record, and is even made by a firm that specializes in musical recordings. One quadrant of this disk is raised above the other three and is equipped with 211 concentric grooves. Each groove carries two letters in the international Morse code. Groove number 107, for example, carries the letters *NM*. If one of the three arms gets into groove number 107, the signal *NM* will be broadcast; the operator's charts tell him what the letters *NM* mean in terms of instrument readings. If the letters *NM* are being caused by the humidity arm, it means a relative humidity of 48 per cent.

Naturally one will ask, at that point, how the operator can tell that these letters *NM* were caused by the humidity instrument. How does he know that it was not the pressure arm or the temperature arm? The answer is that if this should be the first, or even the second, set of letters he hears, he doesn't know. At the third set of letters he does know, because the sequence of sending is coupled with an interruption: it is pressure, temperature, humidity, pause, and so on, as long as the batteries last.

* Deceased.



At the time of the Centennial Exposition of 1876, M.I.T. had been chartered for 15 years, and offered 10 different courses of instruction. Then students attended classes in the original Rogers Building shown above.

THE CENTENNIAL OF 1876— High Tide of Confidence

Exhibits of the Corps of Engineers and of M.I.T. Portrayed the Latest in Engineering and in Engineering Education Seven Decades Ago

By **E. H. CAMERON**

PART II

THE roster of exhibitors at the Centennial Exposition of 1876 is replete with names of industrial firms who are still in business. As we scan the catalogue of devices displayed, we are tempted to exclaim that there is nothing new under the sun, and forget that most of these devices were but crude prototypes of their modern counterparts. To maintain a true perspective as we study the exhibits, it is therefore necessary to recapture the atmosphere of the times, and, for this, Carl Sandburg has provided an apt account of two incidents in the lives of American presidents which occurred about a decade before the Exposition opened its gates. Writing of a speech which Abraham Lincoln gave from the White House balcony in 1865, Sandburg[7] says: "He began to read his speech holding a candle in his left hand and the manuscript in his right." At Lincoln's funeral a few days later, "at 15th Street, one of the horses of President Johnson's carriage began rearing for a runaway, and the President and his companion, Preston King, alighted and took seats in another carriage." The story of these two incidents is of particular value because it emphasizes the limited common comforts of the day, even for those in exalted positions, thereby providing a reasonably qualitative measure of the status of American living in the year 1876.

[7] *Abraham Lincoln, The War Years* (New York: Harcourt, Brace and Company, 1939), 4 vols., $20.00.

To view the exhibits with clear perspective, therefore, we need merely to realize that the man of 1876 had to eat, wear clothing, and live in weatherproof structures, and he had to have means of transportation, then, as we do now. The 1876 fashion of fulfilling these cardinal requirements of life were exhibited. Most of the displays would now appear quite old-fashioned; some would look quite familiar; many novelties would be recognized as prototypes of today's common devices to make life easier; and there were many freaks.

In this article, the review of the exhibits must be limited to those of interest to engineers. While the French carriage, treadmill-propelled by two dogs, might intrigue the automotive engineer slightly, the cathedral-like Swedish porcelain stove draw a superior smile from the heating engineer, and the bow-facing rowing gear cause the marine architect to take notice, there is no point in examining these rather odd exhibits. The exhibits in the fields of mining, steel manufacture, transportation, and power have an 1876–1949 comparative significance, however, and are worth describing. Two exhibits, especially, serve to summarize the 1876 status in the general field of engineering: that of the Corps of Engineers of the United States Army, and the one of M.I.T. — and these deserve and will receive closer examination in a later part of this article.

Survey of Exhibits

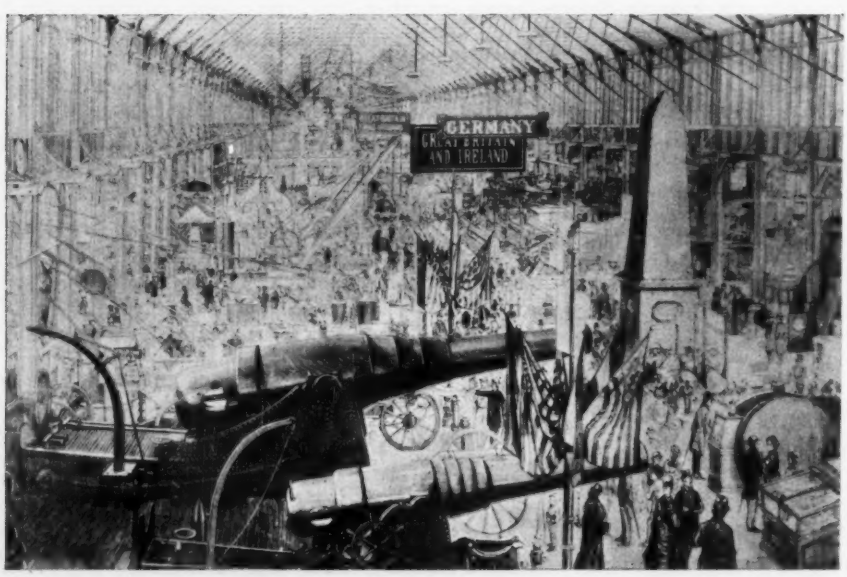
Pleasantly large profits for small mining investments undoubtedly financed the glorious Centennial excursions of many. Poorer people would have one common interest with those who had become rich overnight. They would want to learn more about the apparently limitless deposits of gold, silver, zinc, lead, copper, and coal of the Great West. Thus, the Mining and Metallurgy exhibit topped the list in the classification of the "Official Catalog of the U.S. International Exhibit of 1876." Starting with surface and underground surveys, the catalog lists exhibits on drainage, sinking and lining shafts, tunneling, stoping, and breaking down of the ore, timbering, lagging, hoisting, pumping, and drainage by engines, buckets, or by adits; also, ventilation and lighting. A further classification includes subaqueous mining and blasting. Hydraulic mining, sluicing, and washing are also covered in the catalog.

Competing in interest with the mining displays were the new methods for the manufacture of steel: the Bessemer and the open-hearth processes. Already the production of steel had increased severalfold because of the economy of the Bessemer process over former methods. The infant open-hearth process had still greater promise, and the Centennial booklet of Cooper Hewitt and Company claimed that this company was sole United States agent for this process. The various subsidiaries of this company included rolling mills, wire mills, a chain works, and a horseshoe shop. There were exhibits by The Keystone Bridge Company of the methods used in forming and uniting the steel tubes of the Eads Bridge at St. Louis, completed two years earlier and still serving as an important link in the system of American transportation.

A nickel-plated working model of the 472-foot-long structure of the Raritan Bay pivoted bridge was displayed. Like the contemporary Keokuk pivot span, it differed from prior design. "Previous to 1860, pivot bridges were generally constructed of two disconnected spans, sustained by guys," we learn,[8] whereas the Raritan and Keokuk bridges were self-supporting when revolved on the pivot center. Light and heavy cast- and wrought-iron work for buildings was listed.

Coincident with the practical starts in the new steel processes, and due to be accelerated by the cheaper steels, were the improved modes of transportation. Of course the half-century-old steam railroad industry led at the Exposition. Pioneer research in other fields was under way. Indeed Serpollet's steam boiler with a pressure of 1,000 pounds per square inch, appeared finally to have solved the problem of automotive design, albeit Otto would soon patent his four-cycle

[8] Captain D. P. Heap, The Engineer Department, U.S. Army at the International Exhibition, 1876.



The great Krupp gun dominates the show, as some of the other exhibitors have dominated their respective industries in the ensuing years. A few are: H. W. Johns (Johns Manville), Baldwin Locomotive, Union Iron, Sellers, American Bridge, Pratt and Whitney, Brown and Sharpe, Westinghouse Brake, Hartford Steam Boiler, Jones and Laughlin, Morse Twist Drill, Fairbanks Scales, Tagliabue Instruments, Stanley rules, Studebaker Bros., B. F. Sturtevant, Knabe pianos, Hallet and Davis pianos, Gilbert and Barker, Niagara Steam Pump, Revere Copper, J. G. Brill, Pullman, and Babcock and Wilcox.

Leslie's Historical Register

This patriotically happy family presumably checked the wagon at one of the carriage stands, although they would need to be early on Pennsylvania Day, when one-quarter million visitors crowded the Exposition. Perhaps one of the boys would have to leave the show, to feed the horses at noon, or perhaps his father would tip the attendant to tie on the nosebags. In any event, he would be a busy carriage-stand attendant: horses to clean up after; horses to blanket during the cold fall days; nervous horses to keep from tearing away from hitching posts during summer thunderstorms; sneak thieves to watch.

Harper's Weekly

gas engine, which he had conceived nine years before the Exposition. Evidence exists of pioneer trials of electric locomotives, motorcycles, and cable cars. Aside from the steam locomotive, however, it was the horse who moved people and goods from place to place in the year 1876. The prime mover for short-radius vehicles was the horse. Accordingly, the Exposition provided ample space for carriages, buggies, phaetons, light wagons, omnibuses, and farm vehicles of various types. There were intriguing accessories: horsewhips, sleigh bells, shiny harness, springs, rubber-covered carriage steps, and spokes, felloes, wheels, shafts, and plough handles of hickory or oak. Of the millions who drove to the Exposition behind Old Dobbin, many would enhance their comfort, and his, on future journeys by the purchase of these fine accessories. Southerners would be sure to visit the exhibit of the S. S. Putnam Company of Neponset, Mass. They would recall the hundreds of boxes of Putnam horseshoe nails captured in Virginia from General Pope. Many good Confederate horses would otherwise have gone unshod but for this godsend of the "world's only hot-drawn, hammer-pointed horseshoe nails" – as described in the official catalog of the Exposition.

Of more spectacular interest, however, were the railroad exhibits. Early visitors might not have heard of the plans for the trial transcontinental run, but those who came in midsummer would learn of this still impressive performance of the relay of trains on a run from New York to San Francisco. With Engine 573 (total wheel base of 44 feet, five inches), making the first leg of this trip, the total time for the transcontinental run was 84 hours!

The Baldwin Locomotive Works presented, or perhaps sold, a handsome, bound book which contained line drawings of their several current locomotives. The tables of performance data in this volume indicated that trains of the period had a coal consumption of 34 to 46 pounds of coal per engine-mile; and proudly proclaimed[9] that the eight-car *Atlantic Express* made its scheduled run at 25 miles per hour. Contemporary designs of nearly all present-day track fastenings and rolling stock equipment were shown; there were paper car wheels with steel rims, chilled cast-iron wheels, and a cast-iron steel-tired wheel with a record of having run 460,000 miles. Woodbury's elastic wheel had rubber interposed between the metal parts. Passenger car heaters were listed; also, ventilators, compensating axles, automatic car couplers, and air brakes (the Westinghouse patent was but seven years old). The splendiferous palace sleeping car would be sure to tempt one to view the conquered Great West through its windows, now that the Pacific Railroad had had seven years of safe operation.

Engineers responsible for the design and manufacture of the power system of Machinery Hall were called upon to deliver sufficient power to turn the myriad operating machines in this one-quarter-mile-long building of the Exposition. Happily, the authorities would scan the drawings of the prime mover; the twin engine proposed by Mr. Corliss. It would be big and the very epitome of strength. This behemoth would top a three-story building. Working "nominally," it would do the work of 1,500 horses, and when called upon to exert itself to capacity, could produce 2,500 horsepower. Awed reporters would speak of the miles of shafting that it would drive. Like all colossal beasts, it was ponderous and slow in its movements, but it would be "modern" with the latest 1876 design of air pumps and condensing apparatus. It would conserve its strength like the economical giant it was. When the load dropped off, the Corliss governor would reduce the call for steam by lowering to 25 pounds per square inch the nominal pressure of

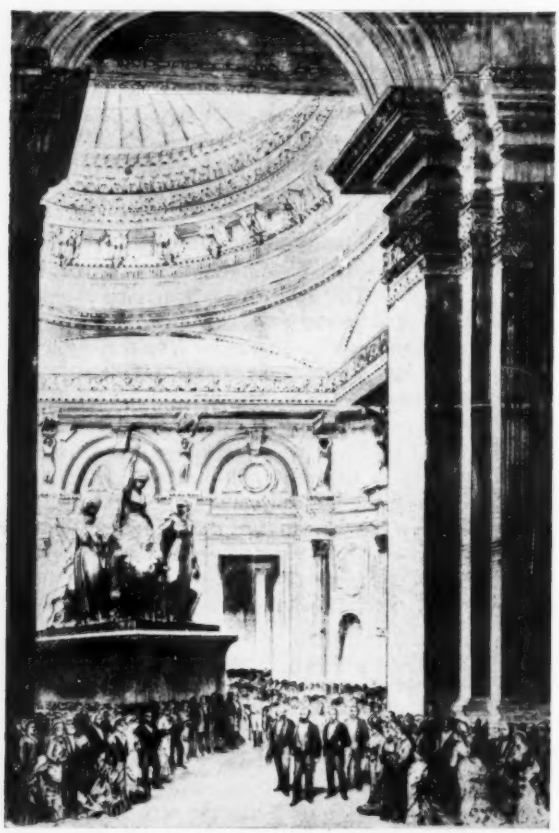
[9] The *Atlantic* of the Baltimore and Ohio, in active service from 1832 to 1893, made 80 miles per ton of coal, as well as rendering good service by hauling Federal troops in the Civil War, according to *Life* magazine (September 27, 1948).

80 pounds per square inch, while the huge engine would maintain its flywheel speed of 36 revolutions per minute.

The Corliss engine provided a splendid medium of publicity, and the program of the opening ceremonies was built around the brief operation of turning on steam by President Grant and the Emperor Dom Pedro, as already recorded in Part I.

That they stood on the threshold of the era of electric power generation, distribution, and transmission, a few foresighted engineers probably realized. Three years earlier (1873) it was discovered that an electric generator would operate as an electric motor when supplied with electric power. This discovery opened up the possibility of transmission of electrical power. Three years later (1879) the first electric power plant in the United States would be established in San Francisco[10] and three years later still (1882) Edison would open his Pearl Street central station in New York City. Thereupon began the modern trend toward prime movers of less and less bulk per unit of power as their capacity steadily increased, thanks to the economies of the modern steam and hydraulic turbines and the driven electric generators. It would be a worthless, but intriguing, speculation to compute the dimensions of today's 80,000-kilovolt-ampere behemoths of power, if designed along the lines of the 1876 Corliss engine which thrilled our grandfathers. Likewise intriguing is the concept of what Corliss and Edison would have produced with today's design facilities.

[10] According to an advertisement of the Pacific Gas and Electric Company in the Boston *Traveler* of April 12, 1949.



Leslie's Historical Register

A military genius, General Grant, in the foreground, has become the symbol of the era of baroque aesthetic tastes. The classic architecture of this scene, as well as the art exhibits, was artistically above par compared to the other buildings and exhibits. Masterpieces of art were shown by Alma-Tadema, Millet, and others; and even by Rogers, whose stilted groups are now sought by collectors.

Merely to maintain our perspective, as we talk of power units of then and now, let us view the small exhibit case of the Smithsonian Institution, wherein is displayed a half-scale model of a 150-horsepower boiler exhibited by Babcock and Wilcox, and dated 1876, the original still a treasured relic. It should also temper our modern pride to learn the depths of the roots of the myriad accessories of our modern power plants as listed in the catalog of the Exposition; the steam, gas, air, and electromagnetic engines; steam gauges, blowers, and seamless tubes; samples of boiler scale and boiler compounds; governing devices; the little giant injector; safety valves; hot- and cold-feed pumps; boiler and pipe covering; low- and high-level water indicators.

Of general interest is the record of the 8th Annual Convention of the American Society of Civil Engineers held in Judges' Hall. Those who attended this meeting would hear the young hydraulic engineer, Clemens Herschel, speak on the "Waves of Translation," and structural engineers could listen to his discussion of another paper on the "Theory of Continuous Girders." General Theodore G. Ellis would predict that "the days of steam and of iron and steel are numbered, and that in the future solar heat will be the motor and aluminum the metal used in their places."

If he likes, the modern engineer may laugh at the exhibits for windmills, bugproof bedspring beds, ice caskets for preserving the dead, and popcorn apparatus of the good year 1876. But may not some of our ideas and present appliances seem equally strange three-quarters of a century hence?

Army Engineers' Exhibit

The impressive exhibit of the Corps of Engineers of the United States Army is significant on two points. First of all, it broke down the field of engineering into two classifications, labeling all engineering except the military as "civil" in the year 1876. Its second contribution was to bring together such information as would present an accurate measure of the part engineers were playing in the building of America.

Evidence of the wide scope of the activities of the Corps of Engineers, which would celebrate its own 100th birthday in three years, was revealed by maps, models, photographs, or drawings. These exhibits included a model of Provincetown and the tip of Cape Cod, illustrations of breakwaters, various harbor and river improvements, lighthouses, steam dredges and snag boats, meteorological and surveying instruments, a steam-drilling scow, a sounding machine, and an electromagnetic chronograph.

Many publications are listed, dealing with such subjects as bitumen, resistance of piles, arch thrusts, compressive values of various woods and stones, and the effect of sea water on iron pile shafts.

Listed with the Army exhibits, but perhaps displayed elsewhere, were the foreign engineering ex-

hibits. France displayed drawings of the Brest cofferdam and several lighthouses. General Garibaldi's map "showing Amelioration of the Tiber and Roman Campagna" was in the exhibit of Italy. The Netherlands had a splendidly comprehensive, illustrated account of dikes and other methods of coast protection showing tide locks and explaining the plan to drain parts of the Zuider Zee to afford protection of river banks by fascine beds, fences, or fagots of osier.

An intriguing exhibit was that of "millmade concrete" apparatus, used at Portland, Maine, and elsewhere. This cubical wooden box, four feet on a side, with a six-horsepower engine drive, would mix 100 cubic yards of concrete in one 10-hour day.

By today's knowledge, both semifallacious and soundly correct conclusions appear in the treatise of Brevet Major General Quincy A. Gillmore, entitled "Portland and other Cements and the Artificial Stone." The Corps of Engineers was represented at tests of cements with samples from Germany, England, the United States, Canada, France, the Netherlands, and Russia. From the records, tensile strength appears to have varied from 22 to 269 pounds per square inch; in compression, failures occurred from stresses of from 122 to 1,439 pounds per square inch. General Gillmore highly commends artificial stone made from hydraulic cements. His definition of Portland cement closely resembles the definition given 35 years later in the 1911 edition of the *American Civil Engineers' Pocket Book* by Merriman.

Very modern indeed appear the cuts of hoisting machinery, dredging equipment, and the Weston differential pulley block of from one- to 10-ton capacity. While the pulsometer looks modern, other pumping apparatus appears elementary, by today's designs.

The subsequent great advance in military engineering is revealed by the exhibits classified as Military Engineering. The fortifications described could serve for the bastions and citadel of old Quebec, but Krupp of Essen, Germany, and also the nations of Russia, Spain, Sweden, the United States, and England provided samples or descriptions of armor plate up to 24 inches in thickness.

M.I.T. Exhibit

As we attempt to recapture the atmosphere of the Centennial period, in the light of technical progress made during the intervening seven decades, it is impressive to realize that there are living today men who were undergraduates at M.I.T. in the year 1876. Fifteen years before the Philadelphia Centennial Exposition, in 1861, the charter of M.I.T. had been granted. Its founders had a magnificent vision of the part which the engineering profession was to play in the grand program of American development. They realized, too, that the Centennial Exposition would provide an excellent opportunity to promote engineering education by an M.I.T. exhibit that would acquaint visitors with the preparation for professional life offered by the pioneering school of technology.

The M.I.T. Exhibit was designed to inspire ambitious young men to matriculate in this school, with so comprehensive a program of engineering attack along the broad front of their country's industrial advance. As these young men scanned the Institute's list of courses, they would learn that no longer should engineering be broken down into but two categories: civil and military. As listed in the Institute's catalogue for 1875 they could choose from 10 courses in engineering and science, as follows:

Course	*Date Established*
I – Civil and Topographical Engineering	1865–1866
II – Mechanical Engineering	1865–1866
III – Geology and Mining Engineering	1865–1866
IV – Building and Architecture	1865–1866
V – Chemistry	1865–1866
VI – Metallurgy	1873–1874
VII – Natural History	1870–1871
VIII – Physics	1873–1874
IX – Science and Literature	1865–1866
X – Philosophy	1873–1874

These courses were conducted in the fine, recently constructed M.I.T. buildings on Boylston Street. Photographs of the buildings, laboratories, and classrooms were part of the Institute's exhibit. Printed documents, descriptive of the Institute's work, drawings by students, models, samples, and instruments were also shown. An important feature was the display of the theses of the graduates of the class of the Centennial year. Today's alumnus will see the names of major prophets of his profession included in this list of undergraduate theses by men who later became prominent, notably, "The Broadway Bridge in Boston" by John R. Freeman, '76; "The Efficiency of Marine Engines" by Charles T. Main, '76; and "The Geology of Eastern Massachusetts" by William O. Crosby, '76.

Ten of the 13 graduate theses in Course I, Civil Engineering, were on bridges, which is easy to understand. Bridge design was then in a state of transition caused by the increasing locomotive loads, and the substitution of steel for wood, wrought iron, or a combination thereof. The urgent need of rational methods of design is indicated by a contemporary writer:[11] "An impression exists in the minds of many persons that it is purely a matter of opinion whether a bridge is safe, or not . . . In 1875 the American Society of Civil Engineers, in view of the repeated bridge disasters in this country, appointed a Committee to report upon The Means of Averting Bridge Accidents." A few months after the theses on bridge design were exhibited, the need for sound engineering in the design of structures was further emphasized by the Ashtabula Bridge disaster in Ohio, in which scores of persons were killed. The remaining theses in the Civil Engineering Course described a waterworks, discussed the water supply of a large city, and included a design for a wrought-iron post truss. Drawing subjects illustrated railroad surveys, topography, stonecutting, and bridge and roof construction.

The seven theses of Course II, Mechanical Engineering, were entitled: "Locomotive Engineering"; "Steam Boilers"; "Screw Propellers"; "The Efficiency of Marine Engines"; "Design of a Mechanical Laboratory";

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[11] George L. Vose, *Bridge Disasters in America.*

This River Called Life

Individual Initiative and True Liberal Understanding

Are Held Necessary to America's Greatness

BACCALAUREATE ADDRESS

By CARL HEATH KOPF

IN addressing the Class of 1949, I am impressed by the fact that more than half of those graduating from the Institute this year have already tasted of life, not alone from the protective sheltering of ivy-covered walls of a college campus, but also through the realistic and personal experiences of the world's most devastating war. This latter experience has had its effect in making today's graduates much more mature than perhaps any other graduating class in history, and certainly there is a great difference between the present generation of college graduates and mine. Today's college generation faces the world and its problems with more realism and sincerity than did my generation a quarter of a century ago. In 1925, when I was graduated from Princeton, we were experiencing in this country a crest of a prosperity wave that made every job look easy and gave almost every college graduate a false sense of security. In what we then regarded as a flourishing era, corporations bid with competitive alacrity for the untried services of the college graduate. There was a general feeling that obviously he was living in the best of all possible worlds and in the best of all possible countries.

But as we look at my college generation in retrospection, we know that the year 1925 was in the middle of what has been, uncomplimentarily, called the Jazz Age – an age of unblessed memory and excess superficialities. One incident of this raccoonskin coat, playboy era will suffice to illustrate the shallowness of the times. I remember that, at my college commencement, the salutatorian's address was given in Latin. Copies of this Latin address were made available to members of the graduating class so that, through diligent attention, they might be able to follow the text, and make the necessary responses. Halfway down this printed address, a copy of which was in each senior's hands, was an asterisk. At this point in the text a footnote suggested, *hic plaudite*. So we applauded. Two-thirds of the way through the text, two asterisks led to the suggestion, *hic plaudite vehementer*. So we applauded loudly. At the end of the address, three asterisks suggested that in conclusion, *hic plaudite vehementissime*. So we applauded most loudly. Our parents turned to one another and exclaimed, "Isn't it wonderful how these young men appreciate the Latin!" Perhaps it is unnecessary for me to tell you that the copies which were distributed to our parents did not include the footnote admonitions which had been printed for the benefit of the seniors!

I give this story merely as an example of the superficial aspects of my college generation. I hope and am encouraged to believe that such practices are absent this year as you face a world which will not be too easy in offering its solutions to your personal and public problems. I am confident that, as mature persons who have seen danger, you will resolutely face the future with courage. There is danger all around us – danger of personal failure, and danger of war on vast and indescribably bloody scale. There is also danger of economic suffering. Indeed millions of our brothers and sisters suffer untold misery at this very hour when so many others seem cushioned against every bump that life might bring.

As you are about to leave the Institute where for four years you have watched sailing on the beautiful Charles River, as did I for many years when I was one of your neighbors here in Boston, it seems to me there is a very close parallelism between the river's flow and the day-to-day events of our lives. In fact, I should like to draw your attention to some of these similarities, especially with respect to this river we call life.

The way we get through this river called life is in many respects similar to the way a man named Holstrom got through the River of the Colorado some years ago. He was the first man to navigate the Colorado alone, traveling in his small boat the 1,100 miles from the upper Colorado to Hoover Dam. The journey took him through 365 rapids and was accomplished in about 60 days. How did he do it?

First, Holstrom built his own boat. After careful study of boats built and used by many another, he designed his own. He selected a design best suited to his peculiar needs, and built to his requirements. He chose just the right cedar log out of the Oregon forest, and had it cut to his own specifications. Then he put his boat together with his own hands, according to the design he had worked out for himself. When his boat was finished, he knew it thoroughly and knew the strength and weakness of every timber and joint in it.

Second, he practiced using that craft on the River Rogue near his home. In progressively more difficult trips on the Rogue, he tested his craft in safe waters before he attempted the hazardous Colorado.

Third, Holstrom learned, soon after he started down the Colorado, that he must sometimes travel with the current and sometimes cut across it. This was a most valuable lesson, for in the tests to come his life would depend on knowing which of these possible courses to pursue under a given set of circumstances.

Fourth, he discovered that he had brought with him considerable excess baggage, or impedimenta as we

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Bridges of Knowledge

Only a Truly Liberal Education Can Supply a Sense of Values and Ample Sources of Inspiration

COMMENCEMENT ADDRESS

By JAMES P. BAXTER, 3D

IN one of the panel discussions of the memorable celebration at the Institute last April, a speaker attempted to dispose of the problem of general education in relation to specialized education by the rhetorical question of who would trust a "generalist," the product simply of a liberal arts education, to design a bridge? This question has been troubling me ever since, for two reasons. The first is that the speaker missed the point when he assumed that general and specialized education are at war rather than complementary. If he is right, then engineering schools are at fault in devoting time and money to the teaching of the humanities and social sciences, and M.I.T. should never have joined in the partnerships which seem to me so fruitful, for the granting of joint degrees with Williams College and 13 similar liberal arts institutions.

I would no more wish to cross the Charles River on a bridge designed by a Williams student, whose education ceased when he completed his major in History or English, than I would care to have my appendix removed by one of our art majors or by the most brilliant of the electrical engineers who will receive their degrees here this morning. But I wish that all those who daily cross the Charles River bridges, whether they be engineers or not, knew that out of a lawsuit involving a bridge across this river came one of the greatest Supreme Court decisions which ever illuminated and shaped our Federal system, and that these passers-by all understood the significance of Chief Justice Taney's decision in leaving so wide a scope to the police power of the State. If your graduates can both design bridges and understand the issues in the great case of Charles River Bridge *vs.* Warren Bridge, they have proved that general and specialized education are complementary.

But the second thing that troubled me about the false dichotomy this speaker on April 1 sought to establish is that there are important bridges which must be built and kept in good order, which will never be constructed save by those imbued with the spirit of liberal education. These are the bridges across the gulfs which now yawn so alarmingly between the three vast areas of knowledge which we often describe as the humanities, the social sciences, and the natural sciences.

To the panel discussion on April 1, Sir Richard Livingston made, it seemed to me, an important contribution. I do not contend that an engineer must be able to read Greek but I submit that if he is unfamiliar with classical antiquity and with the *Legacy of Greece*, which Sir Richard digested in a volume bearing that title, he has missed something of great importance.

It is a good thing for all of us to measure ourselves and our culture from time to time against the Greeks, for there is no better cure for the smugness with which we are accustomed to contemplate our bathtubs, our shiny automobiles, and our present national income of over 210 billion dollars. We have no philosophers that equal Socrates or Plato, no political theorists in a class with Aristotle, no sculptors to compare with Phidias, no bards like Homer, Pindar or Sappho, no playwrights of the stature of Aeschylus, Sophocles, Euripides or Aristophanes, and no orators to match Demosthenes. Our historians have a vast wealth of material at their disposal and a training in historical method lacked by their Greek counterparts, but none of them can write like Thucydides. No contemporary historian would fake a speech, as Thucydides faked the funeral oration he put into the mouth of Pericles; but if one of us tried, he could not write such a magnificent passage as that in which Thucydides distilled the essence of the Periclean age.

I do not for one moment wish to belittle the achievements of the generations that lie between our own times and the Fifth Century B.C. We have got rid of slavery on which Greek society rested, and have given to women a status denied them in antiquity. We have developed communications to a point where the President of the United States, speaking by his fireside or on a public platform, can be heard by listeners the world over; but we cannot be sure that he will speak with the wisdom of Solon.

If Aristotle, for one, came to life again and visited Washington, he would find no building to match the Parthenon, but I am confident that he, like the rest of us, would admire the Lincoln and Jefferson memorials and many of the paintings in the National Gallery. My guess is that what would impress him most in our civilization would be not our comforts and our gadgetry but the progress that had been made over the centuries in advancing basic science. If I may hazard a guess, perhaps the two things that would trouble him most would be the difficulties that now stand in the way of the man who wishes, as he wished, to take all knowledge for his province; and the low standard of political competence achieved by the average American citizen.

Whatever one may say about Athenian Democracy, and when I remind you that it rested on slavery I have presented a terrible indictment, we come off badly when we compare the political competence of the

Athenian voter with that of the average American entitled to mark his ballot or to pull the lever of the voting machine. One proof is that the Greeks could leave to chance the choice of the presiding officer of their largest political assembly, confident that the average citizen could do the job. They found it possible to trust the average voter to perform the highly difficult task of presiding over a large political assembly. How many men are there in the town of Cambridge today who could be capable of handling competently a public meeting of 5,000 persons?

If you were assigned the job of accompanying Aristotle on a fortnight's visit to our national Capitol, perhaps you would find that the thing that would astonish him the most about us Americans is that only half of us who were eligible to vote, took the trouble to vote last November 2. After he had learned, as he soon would, the main features of our political system, he could not conceal his surprise at the fact that a nationwide poll in 1946 indicated that not two adults in 10 had ever sent letters or telegrams to their representatives in Congress, and that similar polls of 1942 suggested that only half the American voters could name the congressman from their district and only 65 per cent of that select group knew what his congressman's attitude was, in the days before Pearl Harbor, on the question of peace or war.

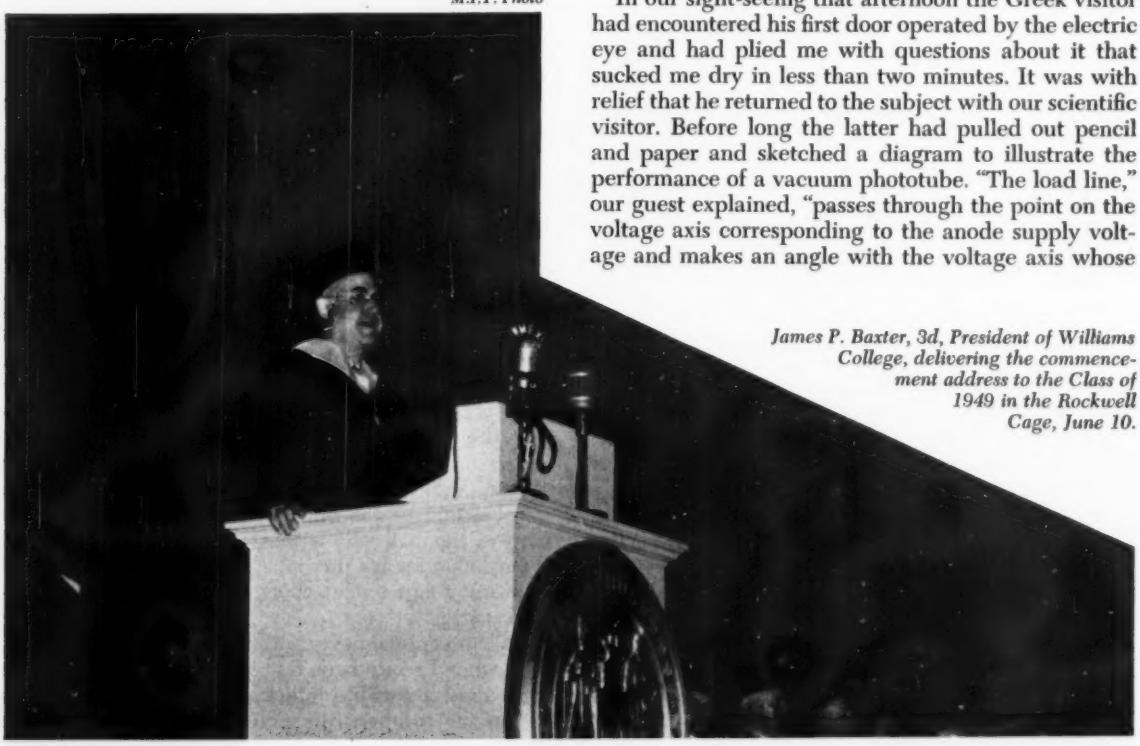
Aristotle would not have spent very long on the banks of the Potomac before asking to meet some men like himself who had set themselves the task of understanding every aspect of the culture they lived in. Let us assume for a few minutes that I had been assigned the pleasant task of serving the Greek visitor as a guide, chauffeur, and private secretary. He soon discovered I was no walking compendium of modern knowledge and he could not understand why I could not find one for him. "Surely, Baxter," he expostulated, "there must be some one in your national Capitol who has taken all knowledge for his province. I do not ask to be initiated in a day into all the mysteries of your wondrous and complex modern civilization but I would like to find a friend with whom I can discuss science and politics, ethics and metaphysics, the nature of law and the art of poetry."

"Indeed, sir," I confessed in some embarrassment, "there ought to be someone in town familiar with all the interests over which your mind ranged so widely in Fourth-Century Athens, but we've gone in for specialization, and the best I can do for you is to ask three friends to dine with us tonight who between them can perhaps provide you with the information you wish. One of them, an important figure in the American Council of Learned Societies, has great competence in what we call the humanities, the second is an acute student of politics, well versed in history and economics, and the third, an engineer of great breadth of mind and salty wit can, I am certain, fill the bill in the natural sciences."

It was a wonderful evening for all concerned and a memorable date in the history of the club at which we dined, but the insatiable Greek became more and more frustrated. First he discovered that the engineer, though one of the most gifted of conversationalists, did not profess to know the whole field of the natural sciences, let alone to have much competence in the social sciences and the humanities. Our other guests confessed that they, too, had mastered only portions of their own special field and each knew little about the interests of the other. Aristotle had acquired, for his visit, a remarkable fluency in English, but it was the English of a cultivated gentleman and not that of our specialized fields of learning.

In our sight-seeing that afternoon the Greek visitor had encountered his first door operated by the electric eye and had plied me with questions about it that sucked me dry in less than two minutes. It was with relief that he returned to the subject with our scientific visitor. Before long the latter had pulled out pencil and paper and sketched a diagram to illustrate the performance of a vacuum phototube. "The load line," our guest explained, "passes through the point on the voltage axis corresponding to the anode supply voltage and makes an angle with the voltage axis whose

M.I.T. Photo



James P. Baxter, 3d, President of Williams College, delivering the commencement address to the Class of 1949 in the Rockwell Cage, June 10.

tangent is equal to the reciprocal of the load resistance (expressed in volts per ampere). Above saturation the characteristic curves in the diagram corresponding to equal increments of light flux are practically horizontal, equidistant straight lines and therefore intersect the load line at equidistant points. This shows that if the anode voltage of a vacuum phototube is always sufficiently high to give saturation current, the current and the voltage across the load resistor are essentially proportional to the flux."

"That may very well be true," replied Aristotle, "but I confess that even with the help of your diagram I have difficulty in following your explanation. Since our other guests also seem to be completely baffled, let me change the subject and ask you why Gallup, Crossley, and Roper guessed so wrong on the outcome of your last election." Since almost as many people have strong ideas about public opinion as about education, the conversation became general. Aristotle soon took three of us out of our depth and proceeded to press the political scientist even more closely. The latter warmed to his subject and was soon meeting fully the one requirement that President Lowell used to say was essential before a subject could be truly deemed a "science," that is, that the language used by those who specialized in the new field must be incomprehensible to a man with only an ordinary education. Our guest, a man with an extraordinary memory, quoted a well-known social psychologist as follows:

"A vote is a vote; it is of no consequence whether the feeling with which it is given is strong or weak, so long as it is on the 'approval' side. This is, of course, a shortsighted position, both for democratic ideals and for the prediction of possible future opinion trends, a matter with which every political leader must be deeply concerned. The writer would suggest that an opinion index of true dynamic significance might be afforded by discovering, through polling, that social-logical continuum on which there would be an increasing skewing of the distribution on the intensity dimension of each succeeding step." At this the rest of us looked blank, and Aristotle threw up his hands in despair. "Think nothing of it," I interjected. "Lindsay Rogers once said he didn't understand that either."

Turning to our third guest, Aristotle asked him what literary theories were being advanced by younger critics. Our expert in the field of the humanities summed up recent trends and quoted the following passage as a sample:

"The work of art, then, appears as an object of knowledge *sui generis* which has a special ontological status. It is neither real (like a statue) nor mental (like the experience of light or pain) nor ideal (like a triangle). It is a system of norms of ideal concepts which are intersubjective. They must be assumed to exist in collective ideology, changing with it, accessible only through individual mental experiences, based on the sound-structure of its sentences. Our interpretation of the literary work of art as a system of norms has served its purpose if it has suggested an argument against the insidious psychological relativism which must always end in skepticism and finally mental anarchy."

"A little windy," said Aristotle, "but I see the gentleman's point." But our guests from the natural and social sciences obviously found the language strange. After the party broke up, my Greek friend expressed his amazement. "By division of labor," he observed, "you moderns have made marvelous advances in extending human knowledge, but you have failed lamentably to integrate your thinking. You say that this Thomas Jefferson, whose monument I admired this afternoon, tried like me to master a wide range of fields of learning but that none of your generation would dare attempt this. How can you expect to reach sound conclusions in any field of scholarship unless you know about the others? Your philosophers and your historians must be a sorry lot indeed. Your guests this evening would, in their individual spheres, put any of my Greek contemporaries to shame, but each seemed to understand very little about the specialties of the others.

"Well," I replied, "if you will come with me to see the Library of Congress tomorrow, it will help you to an answer. I have always thought the most remarkable thing about you Greeks was that you achieved so much without having a public library at your disposal. As a student in Paris in 1925 I was startled to find that the National Library there already housed 440,000 volumes on the history of France alone. When you see the greatest of our libraries tomorrow you will realize better than you can tonight both the advantages and the disadvantages of our stores of accumulated knowledge."

Our visit to the Congressional Library was the high point of Aristotle's visit. I took him first to the main reading room, as I did Thomas Mann on his first visit to the Harvard Library, and pulled out the trays containing the cards bearing his name. Then I took him to the shelves and showed him the texts and the translations of his writings; the biographies and the monographs devoted to his thought. His first exclamation was the same as Mann's, as he handled some of the dog-eared volumes on the shelves, "they still do read me." Then, overcome by the bulk of the two big buildings with their 8,000,000 volumes, Aristotle turned to me and said:

"Certainly, Baxter, your scholars must find the dead hand of the past a heavy one. If they have spent so much time on glosses on my thought, and on other ancient writers, how do they find time and energy to strike out for themselves on new paths? One of our guests last night told me that writers had developed almost no new types of literature since my own time save the novel and the short story, and something which your friend apparently did not regard as so high a form of the literary art, a movie script. We Greeks may have been short of information, such as weights these endless shelves, but the sap of creation ran strongly within us."

Then a new idea struck him, which moved him deeply. "How can you select from this vast mass of knowledge what your young men must master? Is there agreement among you as to certain books which all must study, or do the young lose themselves in these vast storehouses of recorded thought?" "Sir," I replied, "some 25 years ago the Harvard History Department tried to prepare such a list of books in that single field but found that only one work was on the list of every member, your own book, which we call

the *Politics*. I had hoped we could agree on one book more, a study many deem fit to stand beside your own, the book we call *The Federalist*, but we failed of agreement."

It is a serious dilemma we face, that underlies this imaginary dialogue. How can any of us keep abreast of the current production in the arts and sciences, let alone survey the mountainous accumulations of past ages? In medicine the advances of science have been so great that the time for study required of a doctor has steadily lengthened until the date when a man begins active practice approaches ever closer to the date of his retirement. If we rely on the subdivision of labor alone to solve our problem then who will take the comprehensive view?

Unless bridges are built from the area of medicine and public health to the areas inhabited by the rest of us, and unless there is an adequate traffic of ideas across them, how can we count on adequate public and private support for them, on wise legislation in the field of public health or the avoidance of unwise legislation? Specialists in medicine early developed one of the most formidable jargons known, so bristling with $64.00 words as to challenge all competitors. If sufficient translations into the vernacular are provided the traffic on this bridge will be heavy, for we need the information for the conduct of our own lives and the rearing of our children.

But the traffic must not be one-way, for the scientist and the engineer have great need of ideas imported from the areas of the social sciences and the humanities. The recent study by a task force of the Hoover Committees headed by Tracy S. Voorhees revealed shocking waste and duplication in the field of public health, that indicate how far our competence in public administration has lagged behind our medical knowledge. The Federation of Atomic Scientists has done an admirable job in spreading to a wider public a comprehension of some of the problems of the atomic age, but it is only too apparent from some of their writings that the authors lacked a firm grasp of history, economics, and international relations. Let us hope, too, for a large two-way traffic on the bridges between the sciences and the humanities. Marjorie Nicolson has made a great reputation with her studies of the influence of scientific thought on literature. John Livingston Lowes used to ask the students in his class on recent English poetry to read Eddington's *The Nature of the Physical World* in order to get an understanding of the development of scientific thought at the time in which these poets wrote. But let us consider the traffic in the other direction.

In whatever area we live and work, we need what literature, art, music, history, philosophy, and religion can give us. For man needs not only knowledge and skills but a sound sense of values and ample sources of inspiration. With these he can become a human dynamo; without them he is too often a machine stuck on dead center. Helmholtz was, I contend, a better physicist because of his love of music. From what mysterious sources did Faraday, who had so little formal education, derive the beauty and clarity of his style.

Though two wars in the space of 35 years have undoubtedly been the chief factor in the spread of socialism in America, I wonder if another factor of importance was not the decline in the influence of religion. For religion in America, in its many varieties, has never been a state affair, has never emphasized or sought to promote man's dependence on the state but rather his self-reliance and his personal relationship to God. It has been a powerful contributor to the dynamic of individual enterprise, and as its influence has weakened, the road to socialism has thereby been made easier. It is significant that so many of the foes of individual enterprise are foes of religion as well, though I do not mean to imply that all advocates of the extension of government are godless.

This problem, like all the others I have raised this morning, boils down at last to the question of education. It was immensely heartening to me to hear President Killian at his inauguration come out so strongly as he did for breadth of training in the preparation of engineers. That is a long and honored tradition in this Institute, and its outward and visible signs are the long lists of courses in the social sciences and the humanities to be found in your catalogue, the scholarly attainments of your teachers in those fields. Similar testimony to the belief of the M.I.T. authorities in the advantages of broad training is found in the arrangement the Institute has made with 14 colleges, of which Williams is one, for a five-year program of study, three years in the liberal arts college and two years at M.I.T., followed by the granting of both the A.B. and the B.S. degrees by the two institutions. An important option permits four years at the liberal arts college and two years at M.I.T. The system has worked well and proved a practicable solution to the problem of combining general and specialized education for engineers. I recall with pleasure the brilliant performance of some products of this combined system on their Rhodes Scholarship examinations.

As a warm admirer of your great institution, and the head of one of the 14 colleges allied in this joint program, I would like to venture one observation on the problem of combining general and specialized education for engineers. That is, that a great deal depends on the climate of opinion in the place where the education is offered, either at an institute like this, in two institutions allied in a joint program, or in an engineering school that forms part of a great university.

In all the engineering schools with which I am familiar, the departments of mathematics and of physics, to take but two examples, have an immense prestige, comparable to the position of the football team and its coaches at Notre Dame. I would not have it otherwise, but what does concern me is the prestige of the humanities and the social sciences in those engineering schools: not the number of the courses offered, or the eminence of the professors or even the enrollment in the courses, though all those things are important. What I want to know is, how essential do the undergraduates think are these courses in the humanities and the social sciences. And since a climate of opinion is a complex thing, I want to know not only how the students and the administration regard these prestige factors, but how the alumni of the institution and the parents and the prospective employers of the undergraduates regard them.

(*Continued on page 590*)

Doing the Impossible

Our Strength and Stability Lie in Diligently Demonstrating Our Deep and Abiding Faith in Our Free Society and Its Capacity for Self-Improvement

VALEDICTORY ADDRESS

By JAMES R. KILLIAN, JR.

IN speaking to you on this happy occasion, I must first acknowledge a feeling of special kinship with this graduating class. Two months ago you had the responsibility of helping to induct a new president of the Institute and of initiating him into some of the facts of life as students see them. Experienced as you are in dealing with freshmen, you handled a freshman president with skill and forbearance. Fortunately for me, you also demonstrated a spirit of generous cordiality and of good will, which I acknowledge now with heartfelt appreciation.

In a very real sense, therefore, this is my commencement as well as yours, and I shall always feel a special attachment for this class. As we get along in our new careers, I hope that we may remember that we started together and that we may from time to time share our experiences along the way.

In considering what I might say to you today, I have thought of many themes. I could stress your responsibility as professional men to be guided in all you do by the professional ideal of ministering to the public. I could stress your obligations as experts, not to be entrapped by your specialized expertness in a narrow groove. As specialists you have a responsibility to relate your specialty to a broad context of social objectives. I could also point out the importance of your each joining and taking active part in a professional society, and undertaking some community responsibility, in your city, your state, and your nation.

But today, as we start together, I wish to take another direction. I wish, first, to put into the record some of your special characteristics and achievements as a class, and, second, to discuss certain attitudes which seem to me important to young men as they take up their careers in a divided world.

This graduating class has many distinctions which deserve recording as you become Alumni. You are the largest class ever to be graduated from the Institute. The Corporation has awarded today over 900 degrees, which is one-third more than were awarded in the last normal year before World War II. More significant is the fact that you as a group have demonstrated exceptional maturity and scholastic achievement in your work at the Institute. The fact that over half of your class are veterans of World War II is a partial explanation of this record, but I think it also fair to say that our whole student body, perhaps the most highly selective that we have ever had, has shown exceptional performance in the postwar years.

You are also highly diversified in your backgrounds. You come from 44 states and 21 foreign countries. Those of you who received the baccalaureate degree obtained your preparatory training in 410 high and preparatory schools. Those of you who have received advanced degrees obtained your undergraduate education in over 100 colleges and universities. I doubt that your cosmopolitanism is exceeded by any class in any American institution.

As the first class since the war to follow a nearly normal academic course, you had the opportunity – and grasped it – to rebuild our program of student government and student activities, which were partially disrupted by the war. Not only have you made a major contribution toward this reconstruction, but you have given student activities a new vitality and demonstrated that our already effective student government can assume still broader responsibilities in our community life.

During the past four years there has developed an unusually close relationship between students and Faculty, which has been helpful to both. I cite the program of the Student-Faculty Committee in promoting a constructive exchange of ideas between teachers and students on the art of teaching and learning. I recall, also, the open forums which this committee has sponsored on teaching techniques and the new social room which this committee recommended and which has now been authorized, to bring together staff and students for informal discussion of mutual problems.

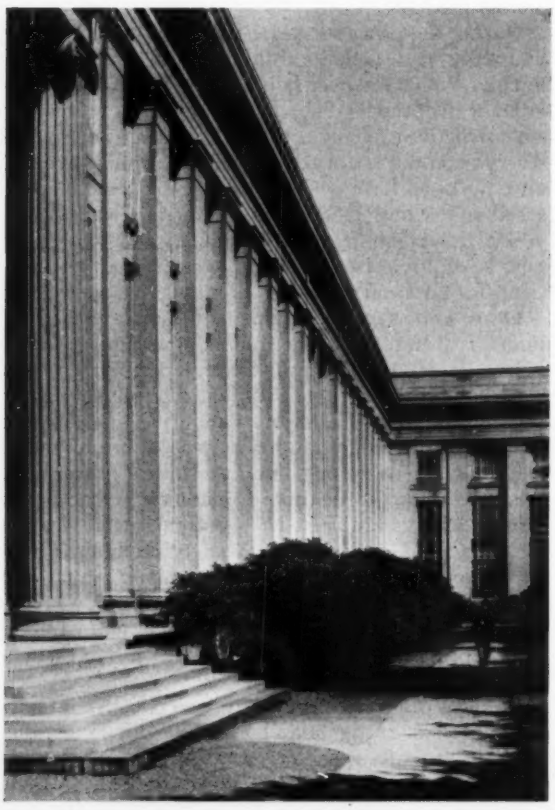
Other important achievements to note are the new judiciary committee of the student government, which brings students into more effective partnership with the Faculty on matters of student discipline, and the reorganized Inter-Fraternity Conference, which has won national recognition for its success in promoting self-government among our fraternities. During the past two years the Institute Committee, which heads our student government, has worked closely with the Corporation Committee on Student Activity, a collaboration that has borne fruit in many ways. The summer program for foreign students, which was carried through so successfully last summer and which is to be repeated this summer, has been a fine demonstration of social action by students.

In many other ways there has been effective interaction between students and Faculty. Our flourishing athletic program represents the fruits of responsible student management working collaboratively with the

staff. The result has been that the Corporation has enthusiastically provided funds as rapidly as they have become available, for increased recreational facilities. The students, on their part, have efficiently employed these facilities, even though they are still inadequate, for operating one of the most comprehensive athletic programs in any college. This past year, 2,500 students, or nearly 75 per cent of the undergraduate student body, have participated in sports, both intercollegiate and intramural. Our athletic program is a fine example of athletics complementing education and not competing with it.

In all of these advances, your class and the classes associated with you have played an important part. The planning which you have done and the representations which you have made to the Corporation and Faculty have aided in setting new goals for the future. The new Development Program undertaken by the Corporation, with its goal of $20,000,000, includes provision for an adequate auditorium, additional student housing, and adequate recreational facilities. These goals, so effectively advocated by the students, have become official goals and we are now seeking funds to realize them.

In acknowledging these advances which you have aided as a class, I have deliberately emphasized that part of our total educational program at M.I.T. which tends, in the minds of those not close to Technology, to be overshadowed by the prestige of our professional education. In my inaugural address I stated as one of M.I.T.'s objectives the development of an environment which performs in the broadest sense an educational function itself, not in a passive way but in a dynamic way. The whole complex of living facilities, activities, and atmosphere must be skillfully arranged to provide the kind of environment which contributes to the development of leadership, breadth, and standards of taste and judgment.



A college essentially is a group of people with a common aim, a company of scholars, to use the ancient phrase. The effectiveness of this community depends upon the quality of the people in it and their willingness unselfishly to work for the common good. This means that the Faculty and students who compose this company of scholars must be guided by a spirit of altruism in all that they do. This is the only fitting way to live in a community that must be altruistic if it is to minister to the mind and to the spirit. I salute the Class of 1949 for the share that it has taken in promoting and maintaining this kind of community.

And now, having looked into your immediate past, let me consider briefly your future, especially certain attitudes which I believe to be important.

I suggest that we might compare your experience in passing from college to a career to that of an airplane passing through the transonic barrier. While you may have considered your work at Technology to have demanded supersonic speed at times, it has actually been but the running start for your professional careers. Until now, your parents, your friends, and your instructors in school and college have been the designers who have provided you with the accelerated take-off, the swept-back wings, and the properly shaped leading edge to enable you to make the transition from subsonic to supersonic flight.

These graduation exercises are evidence that we believe that the design is sound, that your preparation and training have been of unexcelled quality, and that all tests show that you are ready. We say this with the realization that as you pass from academic life into the workaday world, you will encounter the shock waves that always accompany this transition and that these shock waves have a special severity, as we shall see, in 1949. Your encounter with them will call not only for strength and skill but also for a willingness and a determination to take risks and to be bold. You must have that love of adventure which drives men from the comfortable security of the known to the uncertainties of the unknown and mysterious, the sense of adventure that drives men to achieve the impossible, as supersonic flight was once considered.

To have that sense of adventure which leads men to break through the transonic barrier and to explore the world beyond it, a man must possess certain of the ancient virtues: He must be self-reliant and he must possess that disposition to inquire, which we call curiosity. He must have the imagination to see what lies beyond mere personal gratification and he must have courage. With all of these, there must be faith – the substance of things hoped for, the evidence of things not seen. He must be, as William James said, tough minded, which is another way of saying stouthearted.

The sense of adventure which is made up of these ingredients is a quality young men need today as never before. They need it to combat certain current trends which I believe to be dangerous to a peaceful nation and a peaceful world.

The first of these trends is an excessive preoccupation with security – not with security of opportunity but with security from taking risks. Just the other day we had a conference at M.I.T. with a group of industrial representatives who are responsible for the employment of college graduates by one of the great companies. They reported that last year the question most frequently asked by college seniors interviewed by them was: What salary am I to get? This year, however, the question most frequently asked by college seniors over the country is: What kind of pension plan have you got? These industrial representatives were quite understandably concerned that this change in attitude represented something more than a proper tendency to do long-range planning and that it might indicate instead an undue preoccupation with financial security. I hope that this latter interpretation is not correct and that the college graduates of America still have enough faith in themselves, enough self-confidence and adventure to concentrate on the job that lies immediately ahead rather than on the pension that comes with old age.

Ralph Waldo Emerson in addressing a group of students many years ago had some wise things to say about this tendency when he exhorted his listeners to avoid the *maxims of a low prudence*. When young men are willing to renounce their ideals and ambitions for premature comforts and security, "then dies the man in you," he told his student audience; "then once more perish the buds of art, and poetry, and science, as they have died already in a thousand thousand men." "Explore, and explore," he urged. "Be neither chided nor flattered out of your position of perpetual inquiry. . . . Why should you renounce your right to traverse the star-lit deserts of truth for . . . premature comforts?"

The second trend or state of mind which calls for a sense of adventure is the fear and frustration which have occasionally appeared as a result of the war. We hear all too frequently the statement that the war has left us with a sense of frustration and of cynicism. Just the other day I heard a teacher observe that college students sometimes reflect the current mood by exhibiting frustration.

Doubtless this state of mind is a result of the disappointment we all feel that the successful conclusion of World War II did not usher in a period of sweetness and light. Instead we find ourselves engaged in an unremitting cold war, with all of its tensions and poisonous effects.

But why should this aftermath of the war produce frustration and cynicism? Why, in the first place, had we any right to expect that the most destructive war in history, with all of its attending disruptions and exhaustion and hate should be followed promptly by a period of amity and accord and Utopia? To use the figure of a Seventeenth-Century English writer, "The storm is over, the wind lieth, but the ocean worketh a great while." In truth, we had no reason to expect that the tidal waves of hate could be suddenly damped, even though we had high hopes that we could avoid a divided world.

Without minimizing the tensions and the trials of the cold war which we are now fighting, I venture the judgment that this period of crisis can be made a tempering process that will strengthen and mature both nations and people. We can make it so in our own United States if we can avoid the thralldom of fear and frustration. The British historian, Arnold Toynbee, recently made some interesting observations on the possible beneficial effects of the cold war. He told an anecdote about an English fisherman who kept his fish alive in tanks aboard his boat until he came into port. In every tank he put a catfish. The catfish might eat some of the herring, the fisherman admitted, but it kept the others alert, active, and in prime condition.

"Communism is the catfish of the Western herring pond," Toynbee observed. "The cold war, which will last a good many years, in some ways will be more difficult to live through than a war of action. . . . We must learn," he said, "to live with this worry, a difficult thing for many of us who are not used to such an idea. If we can settle down to the cold war, live with it with good nerves, play our cards right, and have enough staying power, we can win. . . . The Russians want to impose or impress a way of life on the rest of the world. I do believe that by being there and worrying us they will cause us to do all kinds of things in our own way to change our way of life and improve it."

This seems to me to be the only proper attitude for us to take in the present crisis. We must accept it as a challenge and meet it, not with fear but with stoutheartedness. Too many American people have reacted to the cold war by cowering before Communism when they should be taking the offensive by confidently stressing the vigor and the permanence of our free society and by working to improve it.

(*Continued on page 592*)

Alumni Day 1949

New Student Housing Unit Is Dedicated as Technology Graduates Its Largest Class of 947. Major Construction Program Aided by $5,100,000 in Gifts

As Technology graduates returned to Cambridge this year for their annual Alumni Day reunion on June 11, they had ample opportunity to learn of the great plans in store for the Institute's postwar role in higher education. They took part in the formal opening of the new dormitory unit on Memorial Drive, saw the new Hayden Memorial Library and the new 12,000,000-electron volt electrostatic generator building under construction, and were encouraged that an apartment house for Faculty and staff would provide additional much needed housing facilities in Cambridge on Memorial Drive adjacent to the President's House. The recently completed Supersonic Wind Tunnel, where aeronautical research will be conducted for the United States Navy, as well as for industry, was dedicated and open for inspection.

Those who preferred a less active program were able to see motion pictures of the recent Convocation and the inauguration of Dr. Killian as the Institute's 10th president. Another film showed the inauguration of President Compton and the activities of Alumni Day in 1930. A third film, in color, portrayed student life at the Institute at the present time.

M.I.T. Photo

President Killian, the Reverend Carl Heath Kopf, and Dean Baker, in usual reading order, as they took part in the baccalaureate services on June 9 in Walker Memorial.

Although Alumni Day was the main attraction for most, a large group of Alumni came to Cambridge earlier in the week to take part in the commencement exercises of the largest class ever to graduate from Technology. A total of 979 degrees was awarded to 947 students of which approximately half were veterans of World War II. This year's graduating class exhibited scholarship considerably above the average, besides taking active part in extracurricular activities. In athletics alone, for example, last year some 2,500 students participated in athletic activities of one kind or another.

At the Stein-on-the-Table Banquet at the Hotel Statler on the evening of June 11, Marshall B. Dalton, '15, in his first report on the status of the Committee on Financing Development, announced that gifts totaling $5,100,000 had been made available to M.I.T. including a gift of $1,000,000 by Alfred P. Sloan, Jr., '95, for the new Sloan Metal Processing Laboratory. And for the first time, Alumni heard a new president – James R. Killian, Jr., '26, – make the annual report to Alumni instead of Dr. Compton who was unavoidably prevented from being present during the exercises of commencement and Alumni Day.

Class Day Events

On June 9, the class photograph was made on the steps of Building 10, immediately preceding the baccalaureate service held at 11:00 A.M. in Walker Memorial. Everett M. Baker, Dean of Students, led the call to worship and President Killian gave the scripture reading. The baccalaureate sermon, "This River Called Life," which The Review is happy to present on page 562, was delivered by the Reverend Carl Heath Kopf, minister of the First Congregational Church in Washington, D.C.

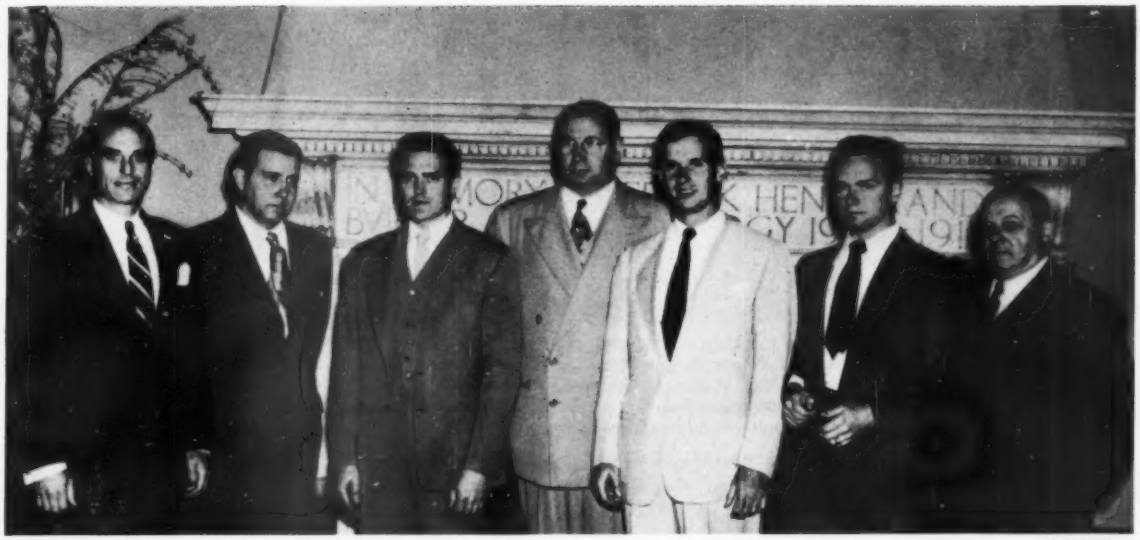
At 2:00 P.M. on June 9, Class Day exercises were held in Walker Memorial in traditional ceremonies in which the graduating class passes on leadership of student affairs to the new Senior Class, as it is officially welcomed into membership in the Alumni Association by C. George Dandrow, '22.

Leonard F. Newton, '49, chairman of Senior Week, welcomed those in attendance and called upon William S. Newell, '99, President of the Bath Iron Works and member of the Corporation, to speak for the 50-year Class. Mr. Newell brought best wishes and greetings from the Class of 1899 to members of the Class of 1949, and admonished the graduating class to "Keep your lathe centers true, trust in the Lord, and you will get along fairly well."

J. Thomas Toohy, President of the Class of 1949, then transferred the class ring to Robert W. Mann, President of the Class of 1950, in ceremonies symbolizing the transfer of student leadership to the new Senior Class.

Ivan J. Geiger, Director of Athletics, then made the first annual award to the outstanding athlete of the graduating class, by awarding a trophy to Theodore R. Madden, '49, who, for three successive years, won the Tech "T" in both hockey and lacrosse, and was captain of the hockey team last year.

Speaker for the 25-year Class was William H. Robinson, Jr., President of the Class of 1924. Directing his remarks to the present state of the American way of



M.I.T. Photo

Taking prominent part in Class Day activities (left to right) *are: William H. Robinson, Jr., '24, speaker for the 25-year Class; President Killian; Leonard F. Newton, '49, chairman of Senior Week; C. George Dandrow, '22, President of the Alumni Association; J. Thomas Toohy, President of the Class of 1949; Charles W. Holzwarth, Secretary-Treasurer of the Class of 1949; and William S. Newell, '99, speaker for the 50-year Class.*

living, Mr. Robinson spoke against the philosophy, advocated by some holders of political office during the past decade and a half, of "getting something for nothing." He urged the graduates to make their own living in the world through their own honest toil, and pointed out how superbly their training had fitted them for the American way of life.

Mr. Toohy then presented a silver service set to President Killian as the gift of the Class of 1949. In accepting this handsome gift, Dr. Killian expressed the hope that this year's graduates would be frequent visitors to the new dormitory where they would be able to see the class gift in frequent use.

In traditional manner the graduating class then applied for admission into the M.I.T. Alumni Association by presenting a skit entitled "M.I.T. Tale of the Century Convocation." This clever skit parodied the recent Convocation by predicting what might occur should the Institute have a similar event 50 years hence when members of the present class would take leading parts in the Technology celebration. Students taking important parts in this skit included: Mr. Toohy, Thomas L. Hilton, Leonard F. Newton, Adriaan P. Van Stolk, Paul E. Weamer, David L. Yeomans, Robert L. King, Ronald L. Greene, Robert L. Nesbitt, and William C. Mitchell. Mr. Van Stolk wrote the words for "We're Marching Today to Tech" for which William E. Katz wrote the music. The skit was staged by James K. Berman.

Next on the Class Day program was the presentation of the Class of 1949 banner to Mr. Toohy by C. George Dandrow, '22, President of the M.I.T. Alumni Association, symbolizing acceptance of the Class Day skit as qualifying the graduating class for membership in the Alumni Association.

Mr. Van Stolk then concluded the exercises with the traditional Beaver Oration, chronicling the history of the Class of 1949 and humorously predicting events which might be in store.

Commencement

Rockwell Cage, dedicated last year as the athletic center for indoor events, was the scene of the commencement exercises of the Class of 1949. In the largest class ever to graduate from the Institute were four women students: Phyllis Ann Fox, Theresa Amelia Uhrich, Elizabeth Ann McElhill, and Jane Berggren Blizard.

Commencement ceremonies were opened with the invocation by Theodore P. Ferris, Rector of Trinity Church in Boston. The commencement day address by James Phinney Baxter, 3d, President of Williams College, appears on page 563 of this issue.

Degrees were presented by President Killian who was assisted in this pleasant duty by Edward L. Moreland, '07, Executive Vice-president; Julius A. Stratton, '23, Provost; William W. Wurster, '17, Dean of Archi-

M.I.T. Photo

J. Thomas Toohy, President of the Class of 1949, turns over the class ring to Robert W. Mann, President of the Class of 1950, during Class Day exercises in Walker Memorial.

M.I.T. Photo

Married couples played a more prominent role than usual during commencement and Alumni Day this year. At left, President Killian congratulates Jane Berggren Blizard and Robert Brooks Blizard, probably the first husband-and-wife team to receive their Ph.D. degrees from the Institute. In the center, Mr. and Mrs. C. George Dandrow, '22, greet Hermann C. Lythgoe, '96, and Mrs. Lythgoe who celebrated their 48th wedding anniversary on June 11. At the right, President Killian beams approvingly on Mrs. Killian who was made an honorary member of the Alumni Association at the banquet on June 11.

tecture and Planning; Thomas K. Sherwood, '24, Dean of Engineering; and George R. Harrison, Dean of Science. Following the presentation of degrees and announcement of honors, President Killian addressed the graduates on "Doing the Impossible." Again it is The Review's pleasure to include this address (page 567) in this issue.

In the afternoon, members of the graduating class, together with members of their families, attended the President's Reception in Walker Memorial.

Honorary Secretaries Meet

While the President's Reception took place in Cambridge, members of the staff met with approximately 50 Honorary Secretaries at the Brae Burn Country Club in Newton for the annual business meeting of this loyal group of Technology ambassadors of good will.

The policies on admission of students, on scholarship, and on alumni activities were described by B. Alden Thresher, '20, Director of Admission; Paul M. Chalmers, Assistant Director of Admissions; Thomas P. Pitré, Dean of Freshmen; and H. E. Lobdell, '17, Executive Vice-president.

In the evening, there were brief remarks by President Killian, Dr. Stratton, recently appointed provost of the Institute, and other administrative officers.

Alumni Day — 1949

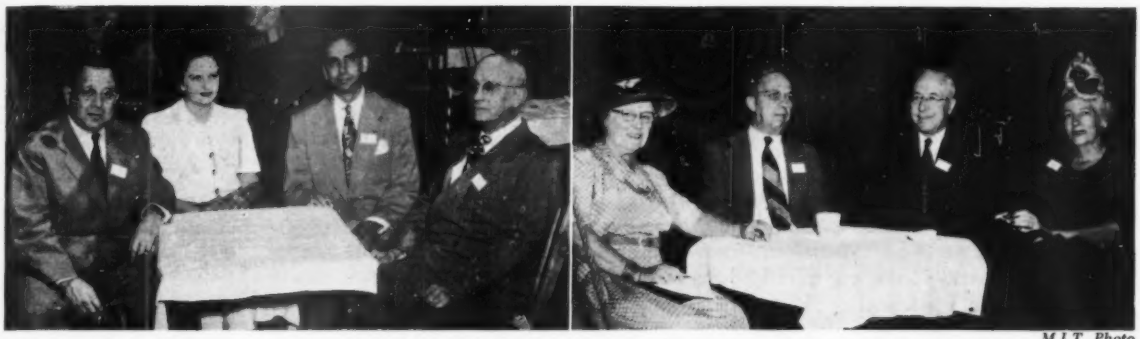
Doors of Building 7 were opened for registration during Alumni Day at 8:30 A.M. to take care of 1,000 Alumni returning to M.I.T. for Alumni Day activities which included opening of the New Dormitory whose construction was made possible by a $500,000 gift from Alumni.

During the morning, trips were scheduled to the Supersonic Wind Tunnel which was opened for the first time, to the new 300,000,000 electron-volt synchrotron, to the Gas Turbine Laboratory, to the exhibition of modern aircraft and automotive engines, to the Rockwell Athletic Cage, to the new Charles Hayden Memorial Library, and to the Eastgate apartments, the latter two of which are still under construction. In Huntington Hall motion pictures were shown of "M.I.T. – 1948," illustrating student activities at the Institute, and of the 1949 and 1930 inauguration ceremonies of Presidents Killian and Compton, respectively.

In the bright sunshine of Du Pont Court, the buffet style Alumni luncheon was held at 12:30 P.M. under canvas in traditional informal and friendly manner. Here, returning Alumni could – and did – chat informally with classmates they had not seen for years, or they made new acquaintances. A separate table was set aside for the 50-year Class, and President and

M.I.T. Photo

Registration for Alumni Day was held in the lobby of the Rogers Building on Massachusetts Avenue. All during the morning, about 900 Alumni, a few of whom are shown here, picked up their tickets, viewed exhibits, or visited points of interest at Technology.



M.I.T. Photo

These two informal groups were photographed during the luncheon on Saturday afternoon in Du Pont Court. In Column 1 are gathered representatives from neighbors to the south: Ramon F. Munoz, '09, President of the M.I.T. Club of Monterrey; Trinela B. E. Bejarano, 2–44; Gustavo A. Calleja, '43, of Havana; and J. F. Barrera, of Monterrey, father of Rodolfo F. Barrera who received his degree and graduated this June. At the other table are shown (left to right): *Mrs. A. Laurence Brown; A. Laurence Brown, '13; C. Adrian Sawyer, Jr., '02, President-Elect of the Alumni Association; and Mrs. C. Adrian Sawyer.*

Mrs. Killian had luncheon with members of the Class of 1899. The Class of 1894 also had a separate table.

New Dormitory

At 3:30 P.M. on Saturday, June 11, the new Senior House was officially opened by a tea and a reception by President and Mrs. Killian and Mr. and Mrs. Dandrow. Visitors had the opportunity of viewing the new structure which was first put to unofficial use during the Convocation, and since then has housed on the average of 50 to 60 Institute visitors each week. Views of the new dormitory (page 578) will hint at its unusual construction; additional information on this serpentine structure was included in The Review for November, 1948.

In dedicating the new dormitory at formal exercises at 4:15 P.M., President Killian outlined the need for the new housing facilities, and indicated that the demand for "on the lot" housing had increased since World War II because so many athletic and other extracurricular activities were now a regular part of student life at M.I.T., and introduced Frank M. Baldwin, Director of Housing and Dining Facilities. Dean Wurster spoke of the building design, pointing out that Alvar Aalto, the architect, had sought to make full use of sunlight while simultaneously providing a view up and down the Charles River for the maximum number of occupants. A. Warren Norton, '21, chairman, Alumni Fund Board, spoke of the role which Alumni played in making the new unit possible.

Alumni Banquet

At 7:00 P.M. approximately 800 Alumni gathered in the Main Ballroom of the Hotel Statler in Boston for one of the famous Stein-on-the-Table banquets which have become the highlight of the annual Alumni Day reunions.

Upon conclusion of the dinner, Mr. Dandrow introduced those at the head table, and called upon Arthur L. Hamilton, President of the Class of 1899. Mr. Hamilton presented a check for $15,000 to President Killian, as the gift of the 50-year Class. William H. Robinson, Jr., President of the Class of 1924, made the presentation of the 25-year Class gift a check in the amount of $81,300, the largest such gift ever to be received, according to Horace S. Ford, Treasurer of the Institute.

Marshall B. Dalton, '15, chairman of the Committee on Financing Development, made his first formal report to Alumni on the work of his committee. Although the fund will not get fully under way until the fall, Mr. Dalton was able to report a gift of $1,000,000 from Alfred P. Sloan, Jr., '95, which will be used for the construction of the Sloan Metal Processing Labo-

M.I.T. Photo

Taking time off for a few informal words before the Alumni Banquet (left to right) *are: C. George Dandrow, '22, President of the Alumni Association; Alfred P. Sloan, Jr., '95, President Killian; and Marshall B. Dalton, '15, chairman, Committee on Financing Development.*

ratory. Also announced at the banquet were other gifts amounting to an additional $4,100,000, or a total for the year of $5,100,000.

President Killian graciously accepted these splendid gifts on behalf of the Institute and called for a few remarks from Mr. Sloan. In response, Mr. Sloan stated that, although his contribution had been called a gift, he regarded it merely as repayment of a debt he owed M.I.T. for the education he had obtained more than half a century ago. It was Mr. Sloan's view that even those Alumni who could not afford to make a contribution in the forthcoming fund drive could still benefit the Institute by spreading the gospel of Technology's needs for capital funds.

Mr. Dandrow then called upon Mr. Lobdell to escort Elizabeth Parks Killian to the platform to receive the certificate initiating her into the Alumni Association as one of its few honorary members. In response to this honor, Mrs. Killian made brief remarks in gracious acceptance.

In concluding the events of the banquet – at which steins designed by Henry B. Kane, '24, were, as usual, a most welcome souvenir – President Killian delivered his annual message to Alumni. It was the first time in many years that this message was not delivered by Dr. Compton who was prevented from being in Boston during Alumni Day, but a telegram from Dr. Compton was read to the assembled guests. President Killian's address "Peace, Work, and Health" follows in full.

Peace, Work, Health

At the opening of the Pasteur Institute of France in 1888, its founder, Louis Pasteur, delivered an address which eloquently voiced the humane ideals of a scientist devoted to the welfare of his country and of all mankind. In the closing paragraphs of this address, he spoke in words which are strikingly appropriate today:

"Two opposing laws seem to me now in contest," he said. "The one, a law of blood and death, opening out each day new modes of destruction, forces nations to be always ready for battle; the other, a law of peace, and work, and health, whose only aim is to deliver man from the calamities which beset him. The one seeks violent conquests, the other the relief of mankind. The one places a single life above all victories, the other sacrifices hundreds of thousands of lives to the ambition of a single individual . . . Which of these two laws will prevail, God only knows. But of this we may be sure, that science, in obeying the laws of humanity, will always labor to enlarge the frontiers of life."

In this time of international tension and unrest, we can gain some comfort from the insight into another period of tension as revealed by Pasteur. More importantly, I suggest that Pasteur's second law – the law of peace, and work, and health – is the ruling concept and ideal of M.I.T. in this year 1949. Our purpose is to enlarge the frontiers of life through science and technology, to contribute to the relief of mankind by the benign application of these two great forces. This is our goal and we can have faith in the power and spirit of our kind of institution to contribute toward the peace and welfare of the nation.

I suggest, too, that if we look within the Institute we may observe the application of Pasteur's law of peace, and work, and health. Certainly we are hard at work, and by every test we are peaceful and in good health as an institution. We have even recovered from the confusion and excitement of the Mid-Century Convocation. In fact, this great event certainly provided a healthful stimulus and a spiritual lift to the entire Institute community which will long be remembered.

Yesterday the Corporation awarded nearly 1,000 degrees, the largest number ever given at an M.I.T. commencement. I am confident that these young men as a group were as well trained to meet the exacting demands of their professional fields, and as well equipped to become good citizens, as any group before them. The group which graduated yesterday had a major part to play in rebuilding our undergraduate life after the disruption of World War II, and I think it fair to say that we now find ourselves with a strengthened student government and a system of undergraduate activities more vigorous than ever before.

Athletics at M.I.T.

We do not usually think of M.I.T. as an institution having a flourishing athletic program, but it does. This past year, over 2,500 students participated in intercollegiate and intramural sports. I hope that during the academic year, some of you may have an opportunity to visit our athletic fields on a Saturday afternoon, to observe the intensity with which they are used and see what a revolution has taken place in our athletic program in recent years. During the past two years we have been able greatly to extend our athletic facilities by the addition of nearly 400,000 square feet of playing space on the West Campus, by the erection of the Rockwell Cage, by the

M.I.T. Photo

The Class of 1899, proudly celebrating its 50th year as M.I.T. Alumni, had its own table under canvas in Du Pont Court for the informal luncheon on Alumni Day which President and Mrs. Killian attended. In this section of the Class of 1899 table shown at the left Mrs. Killian may be seen near the second group of flowers. President Killian stands immediately to the right, with left side toward the camera.

addition of eight new tennis courts provided by the Alumni Fund, by the provision of a new baseball diamond and new lights for field illumination for evening sports practice, and by the provision of a full-time athletic director and additional coaches.

Another example of the healthy condition of our student life at the Institute is the development of closer student-faculty relations and the creation of better opportunities for the two groups to work together for common educational goals. For many years our Student-Faculty Committee served mostly as a mechanism for handling student gripes. In the last two years, this committee has turned its attention to a constructive consideration of educational problems, and we now find ourselves in the interesting and happy situation of having students actively working with the Faculty for the strengthening of our teaching program. During the past year, this Student-Faculty Committee, under the wise leadership of its student chairman and of Professor John T. Rule, '21, of our own Faculty, ran a series of open forums on the art of teaching; the forums were well attended both by students and by staff. At the opening of school next fall, this same committee will sponsor a series of lectures for new instructors on the techniques of teaching. The committee is also sponsoring a plan for the systematic rating of instructors by students. This plan has been carefully worked out to avoid the usual hazards of this kind of thing and to enable students to reach an objective judgment as to the effectiveness of their courses. The Student-Faculty Committee proposed to the Institute that we set aside a pleasant and comfortably furnished room, where students and Faculty members can come together informally, and I am glad to report that we have been able to provide the space and the funds to make this room available.

Housing

In all of this development of a better environment and a more active program of student activities, the most significant event of the year, of course, has been the completion of the Senior House, which was formally opened this afternoon. I hope that the fresh and forward-looking design of this great new housing unit has set the standard for additional new housing units at the Institute, all designed to promote friendly and responsible community living. I am certain that with housing of this kind, we can do a better job in developing that breadth of outlook which must be the hallmark of men who carry the heavy responsibilities of the scientist and engineer. We need additional living facilities to take care of from 1,000 to 1,500 more students on the Institute's campus.

Education and Research

Turning now to the Institute's educational and research program, we have ample evidence that the law of peace, and work, and health is in operation. We have here one of the most outstanding groups of scholars in the world and they are working loyally and with fine morale. They are also opening up new fields of science and technology and developing new educational procedures which are in the pioneering tradition of the Institute.

During the year, our School of Engineering established at Oak Ridge, Tenn., a practice school of nuclear science and engineering, where graduate students in engineering may receive first-hand training in this great new field. During the year the Faculty, with the approval of the Corporation, also established a new program of graduate study in engineering leading to a new professional degree intermediate between the master's and doctor's degree. This program is designed to provide a broader graduate training for those students who do not expect to become research specialists but wish to achieve the breadth that will best prepare them for becoming engineering executives.

To provide the proper facilities to permit our staff and students to do their most effective work, the Institute during the past year has had the largest building program in its history, save for the building of the new plant in Cambridge. The Charles Hayden Memorial Library has been going up on schedule and that part of the library building which is to house the humanities departments will be completed about August 1. Not only will this new library provide a great central collection in the professional fields to which the Institute is devoted; it will also provide the arrangements and the materials which will greatly stimulate our humanities program and will contribute toward our objective of providing a broader educational base.

Still another important facility is approaching completion on the Charles. This is the Supersonic Wind Tunnel, erected with funds provided by the United States Navy and designed to test aircraft and missile models at supersonic speeds ranging from 1,000 miles per hour to 3,000 miles per hour. This outstanding laboratory facility will enable the Institute better to serve government, industry, and basic research in the field of aerodynamics. Its erection is a fine demonstration of collaboration between a private institution and government.

M.I.T. Photo

At the Class of 1894 table (in clockwise order from opening in foreground) *are: Mrs. Warren, Henry E. Warren, Charles G. Abbot, Henry F. Copeland, Samuel C. Prescott, A. A. Treflin* (standing), *Harold M. Chase* (left of Mr. Treflin), *Norwin S. Bean, Walter V. Batson, Charles B. Beach, Mrs. Beach, William H. King, Mrs. King, Mrs. Crary, Horace A. Crary, Mrs. Hunt, and Edward M. Hunt.*

Another pioneering research facility started during the year is the 12,000,000-electron-volt electrostatic generator. This great generator will be used to bombard the nuclei of atoms and will be administered by our Laboratory for Nuclear Science and Engineering. It will also be used for studying the biological effects of high-energy radiation on living and nonliving matter. Still another long-needed laboratory facility was planned during the year and its financing completed. This is the Hydrodynamics Laboratory and Towing Tank. For 20 years, the Institute has been planning and hoping for this kind of facility and it is a great stimulus to our Departments of Civil Engineering and Naval Architecture that we are now to build the laboratory. It will provide an adequate hydrodynamics laboratory on the eastern seaboard for the first time and at long last will make a towing tank available to our students and staff for educational and research uses.

While improving our facilities, we have made encouraging progress in providing a better environment for our staff. Perhaps the most significant move of this sort was the salary adjustment put into effect last autumn. In "take-home" pay, the salary scale at M.I.T., while not the highest, is among the half dozen highest in educational institutions in this country.

During the year, plans were completed for the construction of a large apartment house on the most easterly part of the Institute's river frontage. This apartment house, to be known as "Eastgate," is being financed by the New England Mutual Life Insurance Company and is built from designs developed by the Institute's own School of Architecture and Planning. It provides 261 apartments, all with a fine view of the river and with cross ventilation. In the rental of these apartments, members of the M.I.T. staff will have first priority. This new housing development will contribute toward a more integrated and better-rounded community at the Institute and certainly it will provide ideal accommodations for a large number of our staff members who wish to live close to the Institute.

Finances

The total expenditures of the Institute have continued at a high level. Our budget for the year probably will reach $22,000,000, the highest peacetime budget in the history of the Institute. On this total expenditure of $22,000,000, we will conclude the year with a deficit of $250,000 to $300,000. This deficit results directly from the salary increase given last fall, but it was felt that this increase was so essential that we could properly incur a deficit this year. The increase in tuition which was announced last fall will take effect with the opening of school in September and will go part way in helping the Institute to balance its budget. As the M.I.T. Development Program moves forward, the additional funds it will make possible will help not only in providing better facilities for education and for student living at the Institute but also will aid in stabilizing the Institute's finances. One of the most heartening parts of the current trend in gifts to the Institute is the steady increase in support from industrial corporations. Nearly a quarter of all the gifts received by the Institute last year came from industrial companies.

Administration Additions

In conclusion, let me mention two administrative changes at the Institute which have taken place since April 1. The first of these was the creation of a new post carrying the title of "provost." The provost is an academic officer who shares with the president and the deans the administrative direction of the Institute's program. His primary concern is the administration and co-ordination of educational activities which do not fall within the jurisdiction of any single School. At its meeting in March, the corporation of the Institute elected to this new post Professor Julius A. Stratton, '23, of the Department of Physics. Professor Stratton's background, both in electrical engineering and in physics, his brilliant direction of the Research Laboratory of Electronics, and his membership on the Committee on Educational Survey have provided him with an extraordinarily rich background for his new responsibilities. I am personally delighted and reassured to have him as an administrative colleague and to have available his wise and judicial counsel in discharging my own duties as president.

The second administrative appointment made since April was that of Frank M. Baldwin as Director of Housing and Dining Facilities. Mr. Baldwin will supervise the Institute's increasing facilities for student housing and

(*Continued on page 586*)

M.I.T. Photo

Celebrating its 25th anniversary since graduating from M.I.T. was a large delegation of the Class of 1924. A few members of this Class are shown here, as photographed at the Alumni Day luncheon. In clockwise order are: Sarkis M. Zartarian, Howard E. Whitaker, Maynard L. Harris, Thomas F. Bundy, William W. Sturdy, Mrs. Harris, Walter J. Gress, and Richard F. Shea.

THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

To the Staff

FOUR new academic and administrative posts have been filled recently in the Institute's program of selecting outstanding men to carry out its growing responsibilities in the field of higher education, according to a recent announcement by James R. Killian, Jr., '26, President.

Rolf Eliassen, '32, who received the master of science degree in 1933 and the doctor of science degree in 1935 from the Institute, began his duties on July 1 as head of the sanitary division of the Department of Civil and Sanitary Engineering, in charge of all research carried on in the division. Dr. Eliassen served with two consulting engineering firms before going to the Illinois Institute of Technology as assistant professor of sanitary engineering in 1939. One year later he became associate professor and director of the Sanitary Engineering Research Laboratory of New York University, to which post he returned as full professor in 1946, after serving as a lieutenant colonel during World War II.

John T. Howard, '35, has been appointed associate professor in the Department of City and Regional Planning. Professor Howard graduated from the Institute in 1935 with a bachelor in architecture degree in city planning following his graduation from Yale University. After receiving his master in architecture degree in city planning from the Institute in 1936, Professor Howard became traveling fellow in regional planning for the year 1936–1937. His professional experience includes one year of service with the New England Regional Planning Commission, five years with the Regional Association of Cleveland, consulting work in city planning for the Cleveland Metropolitan Housing Authority, and several years' service as lecturer in city planning at Western Reserve University, Cleveland. From 1942 until May, 1949, he was director of the Cleveland City Planning Commission.

Charles A. Powel will begin his duties at the Institute this fall as lecturer in Electrical Engineering, teaching advanced courses in the use of electric power by heavy industry. Mr. Powel was educated in London, England, and at the Institute of Technology of Canton Berne, Switzerland, and carried on engineering assignments in England and later in Japan for the Swiss firm of Brown Boveri and Company. In 1919 Mr. Powel joined the Westinghouse Electric Corporation and rose to the post of assistant to the vice-president in charge of engineering. Mr. Powel's leadership in engineering was rewarded in 1944 when he was elected to the presidency of the American Institute of Electrical Engineers. In 1946 he was granted leave of absence from Westinghouse to serve as a section chief of the Allied Control Commission in Berlin. In 1948 he served as power consultant to the Stillman Mission, which surveyed the industries of China for the Economic Co-operation Administration.

Frank M. Baldwin is the appointee to the newly created post of director of Housing and Dining Facilities at the Institute whose duties include administration of all undergraduate dormitories, Walker Memorial, the Graduate House, and the Women's Dormitory, as well as Westgate and Westgate West. The increase in dining and housing facilities, with an annual operating budget of $1,500,000, has necessitated the creation of a full-time directorship to handle the growing management problems of these services. Mr. Baldwin is a graduate of the Babson Institute and for the past 18 years has served as manager and later as vice-president of a well-known chain of restaurants in Greater Boston.

Elastic Colloids Research

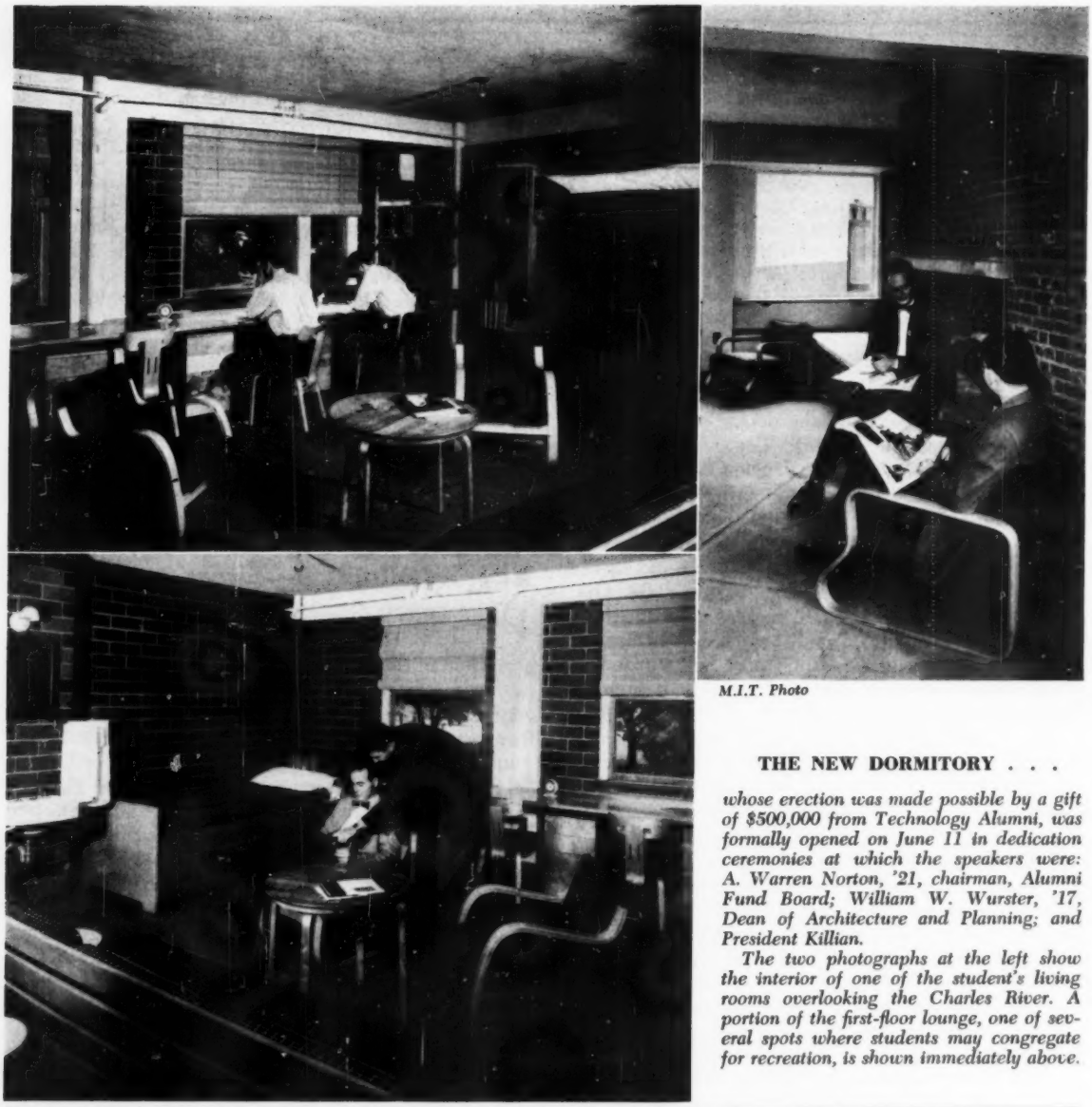
PRESIDENT James R. Killian, Jr., '26, Professor Ernst A. Hauser, and Raymond E. Drake, '08, President of the Elastic Colloid Research Corporation, were the principal speakers at the ceremonies which marked the opening, on May 25, of the Institute's new laboratory for the study of rubber and plastic materials. The laboratory will be associated with the R. S. Crawford Memorial Graduate Research Fellowship, awarded to an advanced student to study rubber and plastics. Both the research facilities for the laboratory and the Crawford Fellowship have been provided by the Elastic Colloid Research Corporation.

The Plastics Laboratory, headed by Professor Hauser of the Department of Chemical Engineering at the Institute, is equipped with the latest types of machinery and testing apparatus used in the rubber industry, and provides facilities for a wide range of research in the scientific field of elastic colloids, specifically natural and synthetic rubber.

Sloan Metal Processing Laboratory

CONSIDERABLE impetus has been given to what President Killian, in his Alumni Day address, has called "a pioneer effort on the part of the Institute to combine in an educational and research program the metallurgical and mechanical engineering approach to the fabrication of materials." Through the aid of a generous gift from Alfred P. Sloan, Jr., '95, the Metal Processing Laboratory is soon to be housed in adequate quarters in a new building to be built on Vassar Street just off Massachusetts Avenue, adjacent to the main group of Institute buildings. Construction of the new laboratory will be started during the coming year, President Killian announced.

By bringing together under one roof all related facilities and staff so that the subjects in metal processing can be taught and demonstrated with modern equipment, the Sloan Metal Processing Laboratory will enrich and extend the Institute's entire engineering program.



M.I.T. Photo

THE NEW DORMITORY . . .

whose erection was made possible by a gift of $500,000 from Technology Alumni, was formally opened on June 11 in dedication ceremonies at which the speakers were: A. Warren Norton, '21, chairman, Alumni Fund Board; William W. Wurster, '17, Dean of Architecture and Planning; and President Killian.

The two photographs at the left show the interior of one of the student's living rooms overlooking the Charles River. A portion of the first-floor lounge, one of several spots where students may congregate for recreation, is shown immediately above.

Strictly Business

ALUMNI President C. George Dandrow, '22, presided at the 269th meeting of the Alumni Council on May 23 at the Campus Room of the Graduate House with 91 members and guests in attendance. President Killian reported on current developments at the Institute, referring particularly to the appointments of Professor Julius A. Stratton, '23, as Provost and of Frank M. Baldwin to the new post of director of Housing and Dining Facilities.

In the first of a group of routine annual reports, the secretary-treasurer presented the results of the recent alumni ballot, already recorded in the June issue of The Review, and reported that eight Faculty and staff members had visited 10 Technology clubs between April 27 and May 17.

The executive vice-president's annual report reviewed the activities of the Alumni Association, The Review, and the local clubs. Attention was called to the progress of the Twenty-Five Year Class Committee and the recently appointed committee which is studying the existing pattern of Alumni Day. The 50th anniversary of The Review and the special Convocation issue were cited in this year's activities.

In its final report the Committee for Consideration of War Memorial recommended that the names of those serving in the Armed Forces during World War II be inscribed on the west half of the north wall of the lobby of Building 10 in keeping with the World War I memorial. Other reports, too extensive to include here, were also presented.

The speaker of the evening, Alan C. Bemis, '30, Director of Weather Radar Research at the Institute, showed slides and motion pictures illustrating the manner in which radar was being used for the daily study of the weather. He indicated briefly the various ways of collecting the weather radar data and of correlating them with the meteorological information obtained by standard procedures.

Survey for Chemical Engineers

THE Visiting Committee on the Department of Chemical Engineering* met with Professor Walter G. Whitman, '17, Head of the Department, Karl T. Compton, chairman of the M.I.T. Corporation, and most of the members of the staff on March 2, 1948, at Cambridge. Committee members present were: Messrs. Wiess, Curme, Thomas, Herty, Murray, and Wilson. Mr. du Pont was unavailable. This report was delayed in order to include results of the surveys hereinafter referred to.

Professor Whitman reported on a number of outstanding honors and special recognitions that had come to various members of the staff, particularly the Priestley Medal of the American Chemical Society and the Lamme Award of the American Society for Engineering Education, both of which went to Professor Warren K. Lewis, '05. It was also noteworthy that members of the staff were taking a more active part in general M.I.T. activities: Professor Thomas K. Sherwood, '24, is now dean of engineering; Dr. Lewis, chairman of the Faculty Educational Survey Committee; and Professor William H. McAdams, '17, chairman of the Faculty this year.

The Department has 42 doctor of science students in spite of having had to eliminate about half of the reasonably well-qualified candidates who applied. In addition, about 20 of the 106 men working for a master's degree will probably go ahead to their doctorate.

The present distribution of enrollment makes a very heavy load of undergraduate teaching, more than double that prewar. The staff is carrying this overload as a temporary proposition, and will review the question of the desirable load as soon as the enrollment is stabilized. Their present idea is to take care of a 30 per cent increase over prewar as against the 20 per cent increase which was proposed to the Visiting Committee in 1947, and which the Visiting Committee felt was inadequate.

It was agreed that the Committee should aid the Department by making a limited survey to compare the probable demand for chemical engineers for the period 1935–1940 with the number hired in 1947, and those expected to be hired during the period 1948–1951. The results of this survey have been given to the Department. While the number of employers surveyed was not large, it did include most of the principal employers of M.I.T. chemical engineers in the past. The survey indicated that the average yearly number expected to be hired (from all schools) in 1948–1951 will be about the same as the number hired in 1947, and about 2.5 times as large as the 1935–1940 average. The expected output of chemical engineers from all institutions appears to be somewhat in excess of this 2.5 to 1 ratio to prewar, so there may be a moderate over-all surplus in those years, particularly of those with bachelor's degrees. However, the M.I.T. projected increase of only 30 per cent will fall well below the demand for their men. Also, the number of doctors of science desired in 1948–1951 showed a sharp increase to 10 per cent of the total. Since many schools give no doctor of science degrees in Chemical Engineering, it would appear that M.I.T.'s percentage should exceed 10, compared with about 5 per cent at the present time.

The overloading of the teaching staff since World War II shows up clearly in the small number of publications; the staff contributed only 12 articles last year. The Committee suggested that, at least during the period of peak teaching load, the Department might well employ an assistant with writing ability who would aid Faculty members in the time-consuming task of putting worth-while theses and research results into form suitable for publication.

The Chemical Engineering Practice School has been re-established and is doing excellent work. The School handles about 48 students a year.

The Committee was gratified to know that, following its recommendation, a school of engineering practice in the field of atomic energy was about to be set up at Oak Ridge, and suggested that the Department should endeavor to "clear" most of the Chemical Engineering staff so that they could visit back and forth and help integrate knowledge of general applicability which had been developed in this new field. It was felt that the Department of Metallurgy should be added to the other Departments encouraged to participate, in view of the great importance of metallurgical problems.

The Committee discussed in some detail the question of the desirability of M.I.T.'s going wholeheartedly into a nuclear-training program, eventually leading to a special course in the subject. It was felt that this offered M.I.T. an opportunity to pioneer in another field, as it had in so many fields in the past, and that the Chemical Engineering Department would probably have to take the leadership in organizing the proposed practice school and in working out the course. It is the feeling of the Committee that the chemical engineering aspects of nuclear research and development have been somewhat neglected because the physicists have naturally been the pioneers and leaders in most of the work done to date.

The Committee favored the Department's plan of broadening the selection of minors for graduate students and particularly encouraged taking minors in English.

* Members of this Committee for 1947–1948 were: Robert E. Wilson, '16, chairman, Lammot du Pont, '01, Charles H. Herty, Jr., '21, Charles A. Thomas, '24, George O. Curme, Jr., Robert L. Murray, and Harry C. Wiess.

Tools for Building Engineering

THE Visiting Committee on the Department of Building Engineering and Construction* met at the Institute on February 17, 1949. C. George Dandrow, '22, and Henry R. Shepley were unable to attend because of unavoidable commitments. The morning session of the Committee was attended by the staff of the Department, and changes in curriculum, the proposed professional degree, space needs for the Department, research in the Department, and placement were presented and discussed.

The Committee feels that the transfer of the Concrete Laboratory to the jurisdiction of the Department is an excellent move, but it feels that the Department should be given ample space, properly related to its

* Members of this Committee for 1948–1949 are: Harry J. Carlson, '92, chairman, John H. Hession, '13, Percy Bugbee, '20, C. George Dandrow, '22, Lou R. Crandall, Henry R. Shepley, and Beauchamp E. Smith.

present laboratory facilities, to cover this substantial, additional load.

The Committee is pleased with the suggestion that conferences or colloquia on our present current problems and techniques in the industry be initiated. Among the several subjects for such conferences it feels that one on "Mechanical Characteristics and Testing of Plastics" and another on "Modular Design" should take precedence at this time. Any such conferences should be based upon, and take advantage of, the unique technological position of the Department, or they should be in areas in which the Department possesses active correlated representation industrially or technically.

In the proposed revisions in structural-design courses, the Committee recommended that the overall pedagogical objective should be to develop an analytical approach in the student, and that routine designs be made only to the extent that they prepare the student to use his theory.

The Committee feels that the proposed professional degree will be helpful for particular graduate students and will give those students who apply for such work an opportunity to round out their training in a more professional way. It is not felt that the Department needs to add any considerable number of graduate courses to accomplish the end sought but that many graduate courses now given in other departments will give much of the needed background.

The Committee has been concerned for some time about the space made available to the Department. It seems that all space changes made to date have been transfers and have provided no additional areas. The Department should be provided with two drafting rooms of its own and this can be accomplished, when space is released by the completion of the Hayden Library, by a return of the old drafting room in Building 5 and the addition of the space now occupied by the Paper Museum, or by providing two drafting rooms and an additional office on the second floor of Building 5. The Committee is interested in the proposed unification of space in a new building on Vassar Street as suggested by the Department. This proposal should be considered as a part of the development program now proposed.

The Committee continues to be impressed with the activities of the Department in the field of research. The work being done in the plastics and adhesives field, under the direction of Albert G. H. Dietz, '32, Associate Professor of Structural Engineering, is unique and stimulating. The extension of the studies on cementation materials, under the direction of James A. Murray, Associate Professor of Materials, should develop many areas as yet not understood. Interdepartmental projects, such as the Solar House, should be encouraged and extended. In general, the Committee feels that the Department should be encouraged to enlarge its coverage of other areas in the field and should be given the necessary space and auxiliary funds to aid in doing so.

Following an inspection of the laboratories, the Committee held an executive session and made several suggestions to the head of the Department on minor matters which would increase the effectiveness of the staff.

Report on Civil Engineering

THE Visiting Committee on the Department of Civil and Sanitary Engineering* held well-attended meetings at the Institute on December 6 and 7, 1948. The Committee is deeply impressed by the progress that has been achieved by Professor Arthur T. Ippen, Head of the Hydraulics Division, in developing equipment and means of instrumentation in the present Hydraulics Laboratory, and especially by the high level on which research in this laboratory is being planned and pursued. In fact, it is quite remarkable that with comparatively restricted facilities, this laboratory has succeeded in covering a very broad field of investigations of very complex and difficult nature. These facts lead us to report that the Hydraulics Laboratory at M.I.T. has become a leading laboratory in this country.

While there are a number of first-class hydraulic laboratories in the West, there are none, at least at present, in the eastern part of the United States. Hence, in establishing the new Hydrodynamics Laboratory, M.I.T. will be fulfilling an obvious necessity, particularly since a laboratory of this type will serve not only as a means for research, but should develop into a center of instruction and dissemination of knowledge on a high level. We, therefore, recommend that the new Hydrodynamics Laboratory be given the highest possible priority in the M.I.T. Development Program.

The Committee reviewed with unusual interest the investigations dealing with the effect of impulsive loadings on reinforced concrete structures being conducted in the Structural Dynamics Laboratory by Robert J. Hansen, '48, Assistant Professor of Structural Engineering, and the plans that have been developed by Dr. Hansen for the development of the Concrete Laboratory during the remainder of this year. During this development, the preliminary appropriation for this purpose will be substantially spent for basic structural changes. While it is expected that some of the equipment for this laboratory can be obtained as a result of sponsored research, it is recommended that an additional capital appropriation be made next year to further the development of this laboratory, and it should be noted that an annual operating account for the Concrete Laboratory will be needed.

In our report of last year, we recommended that approximately $10,000 be made available to build a universal loading frame, which was suggested by Charles H. Norris, '31, Associate Professor of Structural Engineering. Professor Norris showed the Committee a preliminary plan of the apparatus he has in mind and the Committee once more brings to the attention of the Administration the desirability of appropriating the necessary funds. Without equipment of this type, opportunities to participate in structural research programs will be greatly reduced. Small scale model work is of educational value, but is of limited value for general structural research.

(*Continued on page 582*)

* Members of this Committee for 1948–1949 are: Thomas C. Desmond, '09, chairman, Allan R. Cullimore, '07, Richard H. Gould, '11, Harold Bugbee, '20, H. W. McCurdy, '22, Boris A. Bakhmeteff, and Thomas F. Farrell.

BUSINESS IN MOTION

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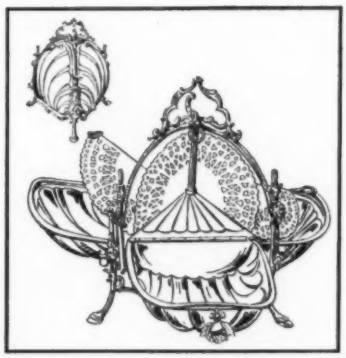

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THE INSTITUTE GAZETTE

(*Continued from page 580*)

The Sanitary Engineering Division brought forth a proposal that the Department should offer the degree, master of science in sanitary science, for students whose backgrounds and interests are essentially of a scientific, rather than an engineering, nature and who wish to pursue work in the fields of Sanitary Chemistry, Biology and Bacteriology, and in Public Health, rather than in the design phases of Sanitary Engineering. It is believed that this suggestion has merit and should be subjected to further study.

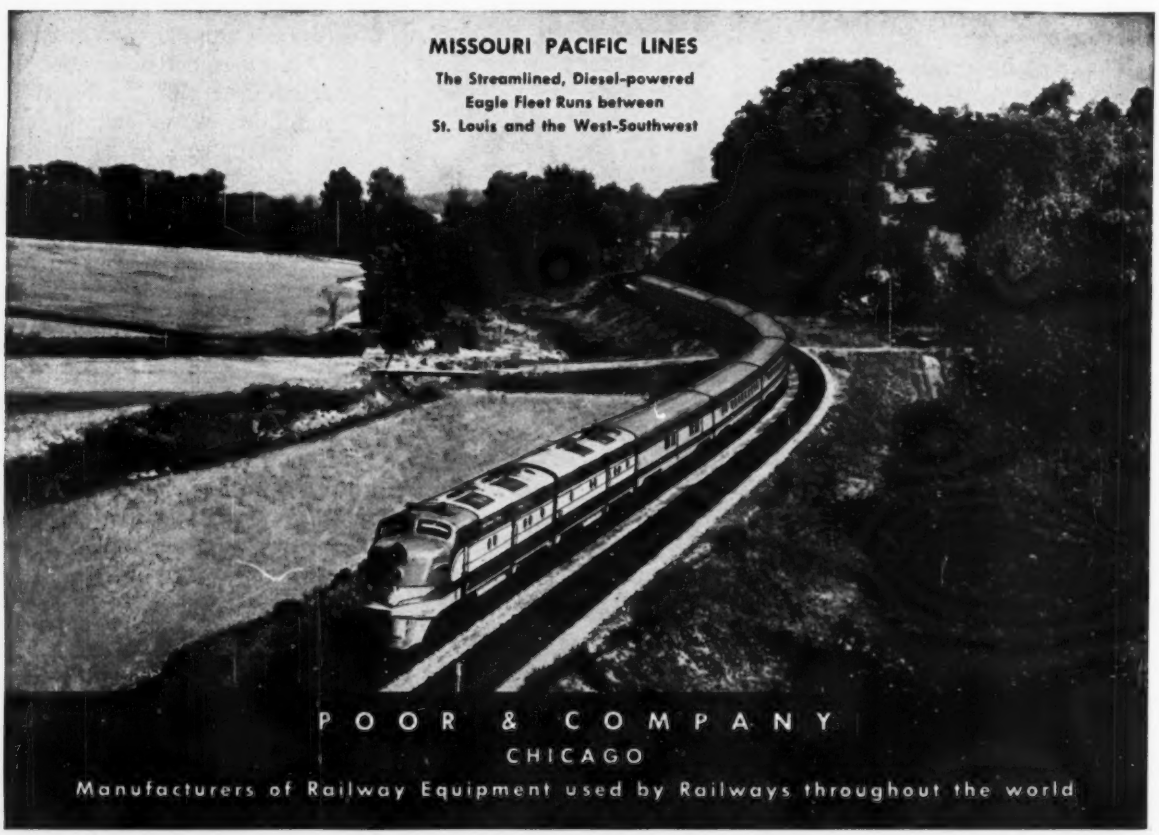
Consideration was given by the Committee to a preliminary report on the possibility of setting up a co-operative undergraduate course in Civil Engineering, involving working periods at the Bureau of Reclamation in Denver, and presumably extended to one or more other organizations. While it is realized that such a program has advantages, the Committee feels that such an arrangement should not be initiated without a great deal of further study. Some of the members of the Committee are inclined to doubt the wisdom of such a co-operative plan, feeling that the benefits to be derived can be largely gained through a judicious program of summer employment for students. The successful efforts of Professor John B. Babcock, 3d, '10, and Herman J. Shea, '33, Associate Professor of Surveying, in locating jobs for students last summer is commended, and it is hoped that such a program will be pursued vigorously next summer and in summers to come.

The new program of Department seminars being run this year under the chairmanship of Myle J. Holley, Jr., '39, Assistant Professor of Structural Engineering, under which 10 outstanding speakers are brought before the students and staff of the Department each term, under the sponsorship of the various organizations and divisions of the Department, is excellent and is in line with recommendations made by the Committee in previous years.

The Committee learned with interest of the proposed two-year graduate program leading to professional degrees such as Civil Engineer and Sanitary Engineer. It is believed that such a program will fill an educational need in the fields of Civil and Sanitary Engineering, and that these new degrees should be offered by the Department.

In conclusion, the Committee is impressed by the fact that the Department staff now includes a relatively large number of young men, many of whom are graduates of other institutions, and that activities are not entirely confined to the classroom. Noteworthy in the latter aspect is the participation of Donald W. Taylor, '34, Associate Professor of Soil Mechanics, and his assistant in the proceedings of the International Soil Congress in Europe last summer and the current preparation by structural staff members of authoritative textbooks. It is believed that these are important factors in accounting for the vigorous atmosphere which now typifies the Department.

(*Concluded on page 584*)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SCULLY SIGNAL COMPANY
70A First Street
CAMBRIDGE 41, MASS.

THE INSTITUTE GAZETTE

(*Concluded from page 582*)

Projects for Health

ALL but one of the members of the Visiting Committee on the Medical Department* were able to attend the meeting which was held on March 18, 1949. The work of the Department was discussed with President Killian, Dr. Dana L. Farnsworth, Medical Director, and Malcolm G. Kispert, 2–44, Administrative Assistant to the President. The meeting which continued through luncheon provided opportunity for many points to be considered, and inspection of the Homberg Infirmary.

Your Committee is very well satisfied with the work of the Medical Department. The care of the student body as carried out by the Department is excellent, and we believe that the work is being done as economically as is possible when one considers the quality of the service given.

Dr. Farnsworth has instituted several projects which we believe are of especial value:

He has interested the Technology Matrons in instituting a Nurses Aide program. This has been very successful and there is now a group of experienced women who can be called upon for help in case of a disaster or an epidemic. The program has had the hearty approval of the Nursing Service. In line with the above, an arrangement has been made with the Massachusetts General Hospital in case of a disaster or an epidemic. The hospital will take any patients Dr. Farnsworth wishes to send them on short notice, and also will send out a team of experienced doctors to aid in the work in the Infirmary, should that be necessary.

An interesting program in occupational medicine has been set up by Dr. Farnsworth with coverage of all of the personnel of the Institute. This is pioneer work and should minimize the occupational hazards met with in the various departments. As part of this program, a Safety Committee is being organized to cover these hazards geographically throughout the Institute, and a safety engineer has been authorized to implement the complete program. This whole matter is of great interest and it seemed to the Committee that it would be well if Dr. Farnsworth would carry out his suggestion of obtaining either one or more Fellows from some of the medical schools who would be carried on his staff. As far as we know, this would be a unique opportunity for the training of men in the field of occupational medicine. Work in an industrial plant will cover only one phase of this subject; at M.I.T. many phases can be covered.

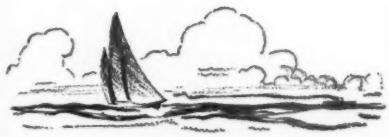
More room is needed for expansion of the Department and that will be forthcoming as soon as the Hayden Library is completed. Your Committee feels that the Corporation and, in fact, all departments of the Institute may well be proud of the M.I.T. Medical Department.

* Members of this Committee for 1948–1949 are: Dr. William J. Mixter, '02, chairman, Samuel C. Prescott, '94, John R. Macomber, '97, Dr. James H. Means, '06, Dr. Egon E. Kattwinkel, '23, Dr. Arlie V. Bock, and J. Willard Hayden.

In the days when cattlemen drove their stock across the unfenced prairie to the railhead, it was common practice among the least scrupulous to feed the cattle plenty of salt before they were offered for sale. When they were allowed to drink their fill, the gain in weight was the buyer's loss. Hence the term "watered stock" sensationalized in early days of corporation revelations and regulations.

Print from Bettman Archive

Are you selling "WATERED STOCK?"



WATER is just about our commonest material. In many places it is indispensable; in some places it is beautiful; but in others it contributes nothing but extra weight and the risk of depreciation. To send a six-ounce orange North from Florida freight must be paid on over five ounces of water which the North has in abundance — and then it must be eaten quickly before it rots.

BLOOD PLASMA

When World War II darkened the horizon Army doctors looked beyond the outright slaughter to the millions of wounded who might die in the field. Blood transfusion could save many but in a remote, devastated theater of war it was unthinkable — unless blood collected from a healthy population could be reduced, preserved, transported and reconstituted. To make this possible National Research Corporation took low temperature, high vacuum dehydration from the laboratory and developed it to the level of mass production.

PENICILLIN

Faced with an urgent wartime need for a universal antiseptic the English recalled the experience of Alexander Fleming with the blue-green mold, Penicillium Notatum. Under pressure the wonder antibiotic was accumulated — enough for a mouse, enough for a man, enough for twenty men — and then, grown by "kitchen culture" in millions of milk bottles, enough for an army. Again there was need for dehydration without heat damage and National Research's high vacuum process now installed in substantially all of the larger plants throughout the world, turned penicillin into powder at a rate to supply the world.

ORANGE JUICE

During the war we experimented with the dehydration of many common foods; meat, fish, vegetables, fruits, coffee. Of these orange juice was the most promising with a nationwide market ready and a world market waiting. We had produced citrus concentrate and powder on a pilot plant scale. Near the war's end we organized Vacuum Foods Corporation. For them we built and equipped a plant in Florida that now concentrates, for the national market, 75,000 gallons of juice a day.

This new industry, producing some 4½ million cans in the 1946–47 season is expected to reach an annual production rate of 200 million in 1949. Within five years it is predicted that one-fourth of all Florida's oranges will reach their market as concentrated juice. In this industry Vacuum Foods is the pioneer and leader.

COFFEE

The success story of orange juice will, we hope, be rewritten for coffee. For over a year we have been producing in small quantity a "crystalline coffee" — pure coffee essence, nothing more and *nothing less*. This small production is being market-tested through the local retail trade and a steadily increasing number of users have found out that coffee *can* be reduced to an instantly soluble concentrate, and still taste like good coffee.

WHAT NEXT

To anyone who is selling "watered stock," not with guile but from necessity, National Research can offer a new prospect — lower cost methods of producing dry materials with instantaneously soluble structure. To apply our proven techniques of high vacuum dehydration National Research Corporation stands ready with a carefully chosen, experienced staff, with the newest equipment and with an accumulated knowledge of large scale low temperature dehydration that cannot be equalled anywhere.

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ALUMNI DAY, 1949

(*Continued from page 576*)

dining services, to assure effective centralized direction. These services are now valued at over $5,000,000 and have more than $1,500,000, as an annual operating budget. Mr. Baldwin's duties include administration of all undergraduate dormitories, the Senior House, Walker Memorial, the Graduate House, and the Women's Dormitory, as well as our housing project for married students, Westgate and Westgate West. He has had valuable experience which ideally qualifies him for his new post. We are happy to welcome him to M.I.T.

No institution is blessed with a stronger, more loyal, and more effective group of administrative officers than the Institute, and I wish to pay tribute to their skill and forbearance in easing your new president's adjustment to his new responsibilities. The administrative group, working in close concert with the Faculty, gives the Institute a unity and a harmony which are great sources of strength. I do not believe it would be possible to find a group of Faculty members and administrative officers more completely dedicated to scholarship or more loyal to the ideals of our free American society.

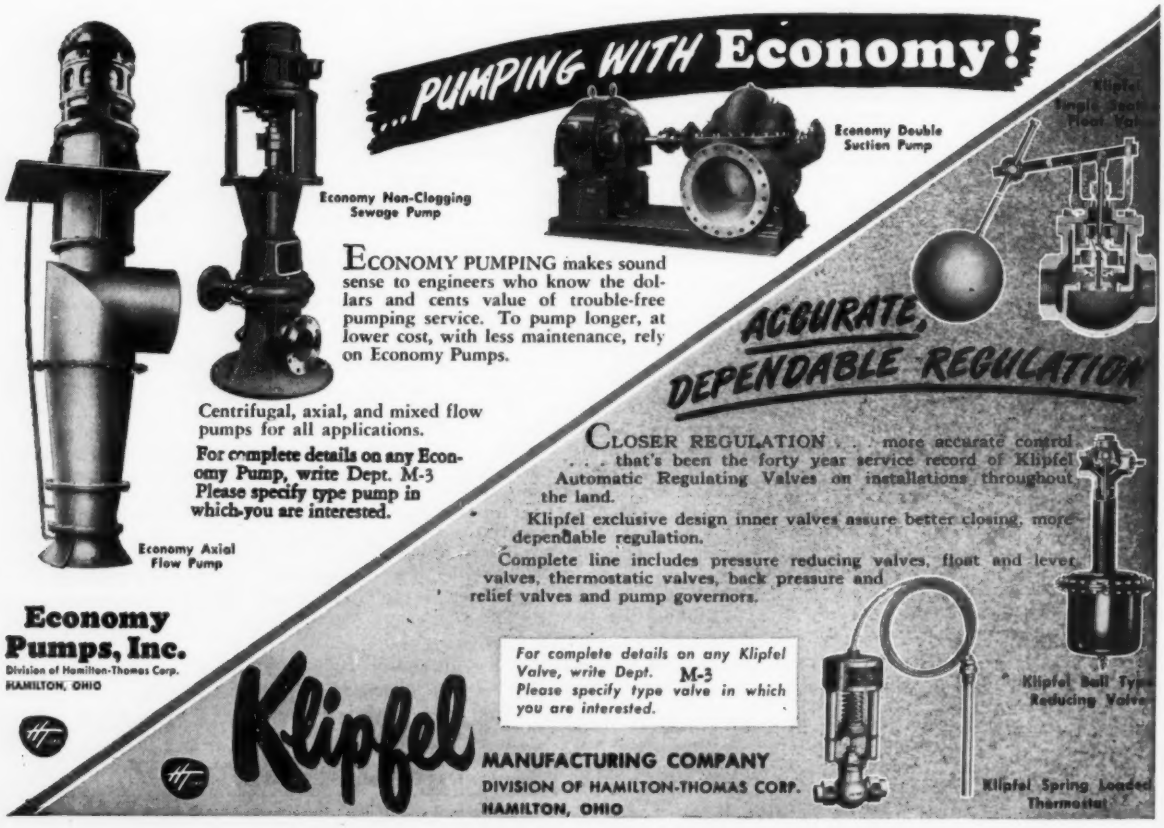
Technology Alumni

Working in full concert with the administration, the staff, and the students stands our great body of Alumni. During the past year, we have had two examples of the strength and the loyalty of our alumni group. One is the response which Mr. Dalton has received in the organization of our Development Program. Almost to a man, the Alumni who have been asked to take part in the organization have responded generously and with enthusiasm. The other example was the welling up of Technology spirit at the Mid-Century Convocation two months ago. One of the observations we most frequently heard about the Convocation from our guests from outside the M.I.T. family was that M.I.T. demonstrated extraordinary unity and coherence. All groups seemed to be working for a common purpose.

May I also express to the Alumni our appreciation for the continued generosity which so many Alumni are expressing through the Alumni Fund. Within a fortnight, the Alumni Fund Board has completed an appropriation of $250,000 to the Institute to insure the completion of the Charles Hayden Memorial Library and, as you know, a year or more ago the Board allocated, out of its accumulated funds, $500,000 to insure the completion of the Senior House. By this policy of supplementing other funds, the Alumni Fund is putting its resources to work in the most effective possible way and is lending a hand to the Institute where it is most needed.

And while speaking of our Alumni, let me cite an interesting report which was recently published in the journal, *Mechanical Engineering*, about the college antecedents of successful engineers. We have always known that M.I.T. Alumni are outstanding, but here is statistical evidence. A study of the college alumni listed in *Who's Who in Engineering*, as reported in this article, indicates that M.I.T. leads the list of the 362 institutions represented, with a total of 933 names. Not only does it head

(*Concluded on page 588*)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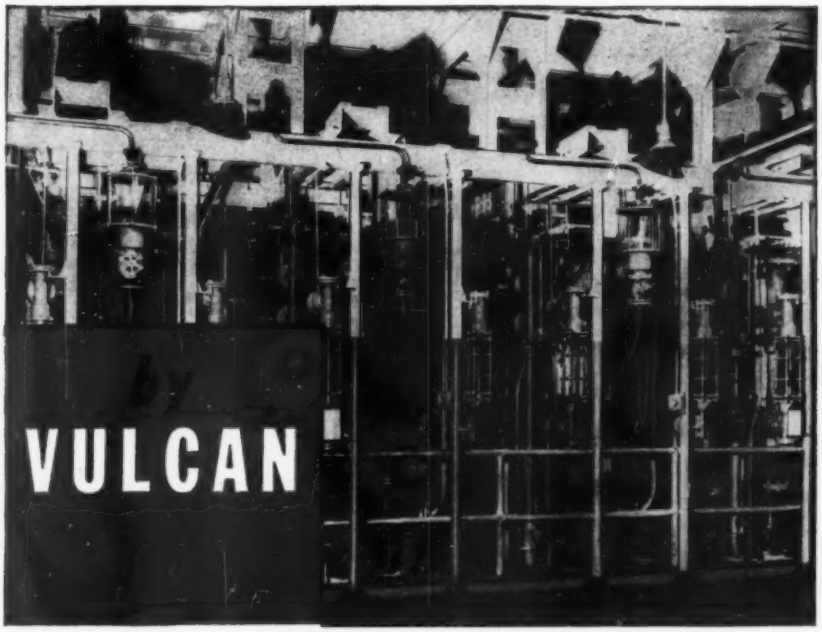

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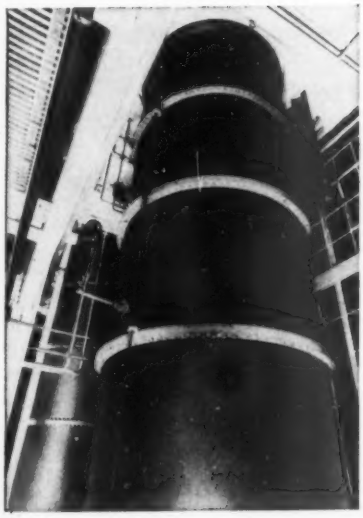

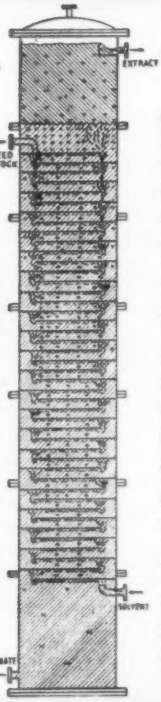

At right: Diagrammatic sketch of a liquid-liquid extraction column.

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ALUMNI DAY, 1949

(*Concluded from page 586*)

the list; it stands substantially ahead of the next competitor. Perhaps more significant is the fact that the percentage of living Alumni of the Institute who are listed in *Who's Who in Engineering* is higher than that of any other institution. The figure given would be substantially higher than it is if the number of living alumni used had been limited solely to our engineering graduates. Still another notable deduction to be drawn from this study is that two institutions, both privately endowed, furnished one-eighth of all the engineers listed in the 1948 volume of *Who's Who in Engineering*.*

Here is evidence of the leadership of the privately endowed institution. Here is verification of what we have been saying in our Development Program that our privately supported institutions deserve the continued support of our free enterprise system. Here is evidence of the importance of our present objective in funding M.I.T.'s independence.

Such in rapid review are some of the evidences I would present to you that the Institute indeed has taken as its ideal Pasteur's law of peace, and work, and health. As an institution we are striving to make a maximum contribution toward the welfare of our nation and of mankind in working unremittingly not for new modes of destruction but to deliver man, as Pasteur said, from the calamities which beset him and to enlarge the frontiers of life.

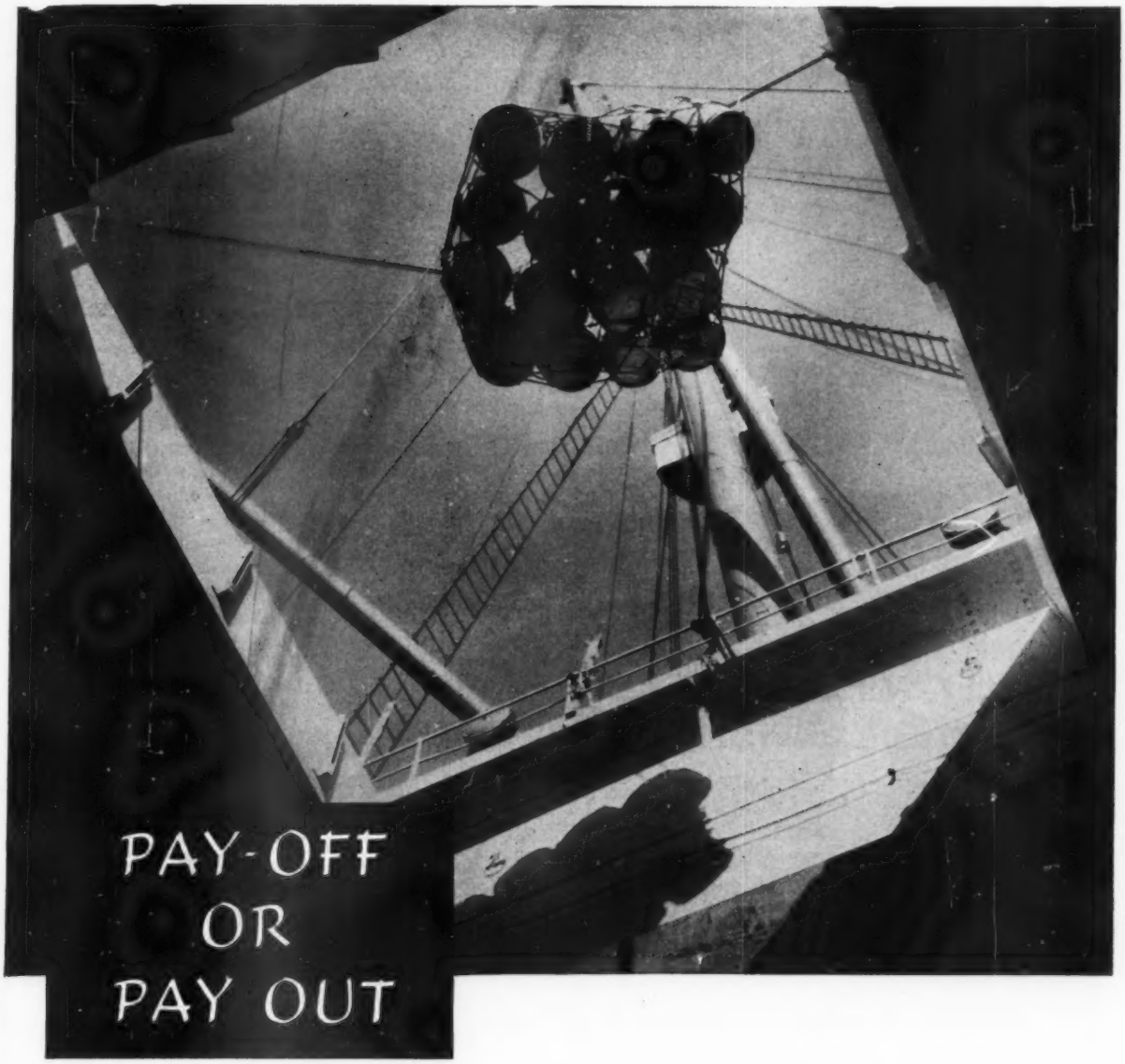
By 10:00 P.M., when President Killian had concluded his address, the banquet was declared adjourned by Mr. Dandrow. But although alumni day, 1949, was thus terminated, many an informal group got together in hotel rooms, or in the homes of Alumni residing in Greater Boston, for a continuation of one of those pleasant reunions which have done so much to stamp the seal of unity on Technology graduates.

In Retrospect

In certain respects, this year's Alumni Day was unusual. It was the first one in many years at which Dr. Compton was unable to be present in person, and it was the first since 1930 at which a new president – an alumnus of the Institute – took part. It was the first in a decade at which no symposium papers were presented; the many very able addresses which were presented this year at the Convocation early in April adequately fulfilled the need customarily supplied by symposium papers. Those who came to Cambridge saw a huge program of construction already under way, and learned of other units to be added to Technology's educational facilities.

But Alumni Day, 1949, was also different in its look toward the future. There was an air of activity about the place; not the nervous, tense activity of the war years but rather the activity which marks the slow, steady, studied march forward in a new postwar era under a new leader. Not so new, however, was the same steadfastness of purpose which has characterized the Institute during its formative period under William Barton Rogers, through the Augustan age of Richard Cockburn Maclaurin, the Olympian age of Karl Taylor Compton, and now to the burgeoning era of James Rhyne Killian, Jr.

* Additional details are given on page 555.



Loading and unloading are the most critical moments in the life of your cargo. A parted rope would mean damaged cargo . . . a loss for shipper, carrier or consignee, instead of profit.

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1949—OUR 125th ANNIVERSARY YEAR

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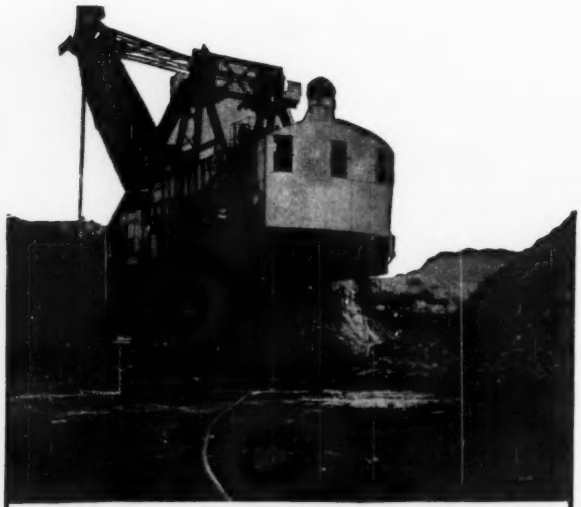

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BRIDGES OF KNOWLEDGE

(Continued from page 566)

I have recently lost to the California Institute of Technology an outstanding professor of English Literature who will become their dean of humanities. I had held him against other competing offers but in Pasadena his office and his classroom will be in walking distance of the great Huntington Library, from whose treasures my friend has already drawn the substance of two books during earlier visits. The surroundings will be delightful and it would be hard to find a better man to work for than Dr. DuBridge. The set-up of courses and the teaching load are satisfactory, the administrative duties are not heavy, or at least they don't appear so from a distance. The one question that troubles me, as a friend and well-wisher, is the climate of opinion. My friend happens to be as brilliant a teacher as he is a scholar and he is adept in angling for the fish that is hard to catch. He and I know that mathematics and physics will have a prestige on the Pasadena campus that none of the humanities can match. But just how wide will be the gap that separates them. What bridges can be thrown across it? Will the traffic on them be one-way or two-way?

Here at M.I.T. you have excellent programs in many of the humanities and social sciences, you have a fine library, soon to be superbly housed, and access, three miles away, to one of the world's greatest libraries. In

(Concluded on page 592)

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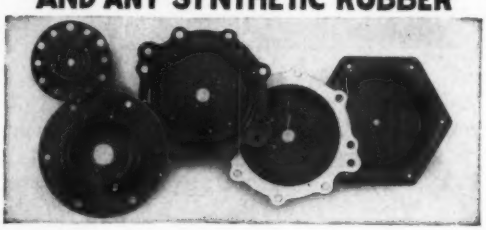

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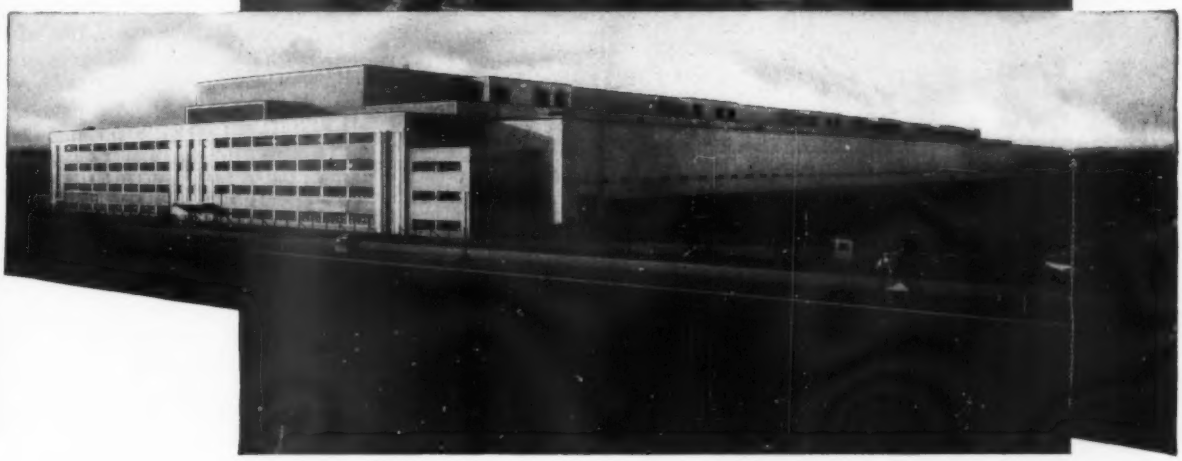
Interior of General Electric Turbine Building, Heavy Equipment Area.



To meet the growing power demands of industry, General Electric Company retained Stone & Webster Engineering Corporation to design and construct at Schenectady, New York, its new turbine manufacturing plant.

The building, which is 650 feet wide by 1290 feet long, has a total floor area of more than 1,000,000 square feet. It required foundation construction of unusual design to carry the heavy loads to be superimposed on the manufacturing floor, which comprises nearly 20 acres.

This plant when in full production will be capable of producing each month enough turbine-generators to supply power and light for a city of a million inhabitants.

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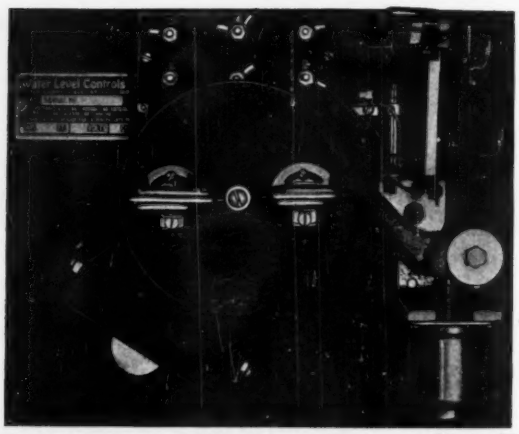

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BRIDGES OF KNOWLEDGE

(*Concluded from page 590*)

Cambridge and Boston combined, you have one of the intellectual capitals of the world, where your students can find great preaching, art, drama, and music, if they have time and inclination for them. Your administration favors a well-balanced program and your gifted Dean of Humanities, John E. Burchard, '23, will woo the students to these treasures of culture with the enthusiasm of a Pied Piper. For the success of the well-balanced program, so admirably sketched in his inaugural address, I hope and pray that President Killian will have the support of all hands, his Faculty and Governing Board, his Alumni, the parents, and the prospective employers of his undergraduates.

Although I knew precious little of science until I was 50, it fell to my lot in wartime to become the historian of the Office of Scientific Research and Development. In the course of my labors I came to know many of your professors, and of your Alumni, and to have an immense respect for them. I do not know all of M.I.T.'s contributions to the winning of World War II, but I know enough to say that no educational institution did more. But on a commencement morning one looks to the future, not the past. I see the Institute contributing in years to come not merely in the advancement of knowledge in ever-narrowing, ever-multiplying specialized fields, but flinging bridges across the gulfs that separate these fields: bridges with two-way traffic that bring both to your students and to the world, not merely specialized knowledge but integrated knowledge. For general and specialized education are not hostile but complementary, one and inseparable, now and forever.

DOING THE IMPOSSIBLE

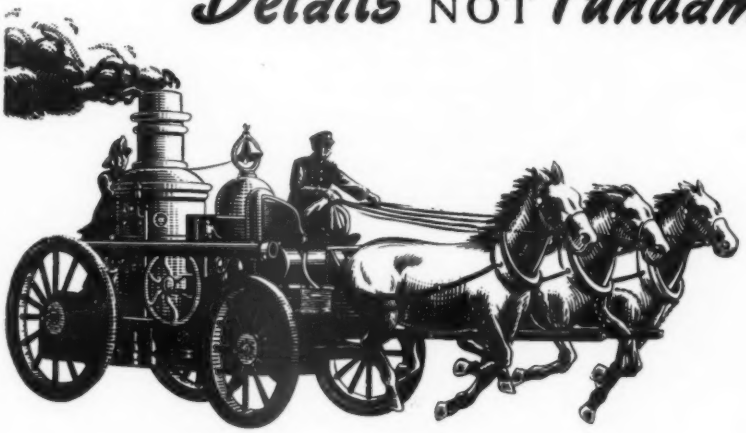
(*Continued from page 569*)

Certainly we must implacably resist fifth-column danger to our freedom but we must always be sure that our methods of combatting this fifth column do not irreparably damage our basic liberties. Our strength and stability lie not in a vain effort to impose an intellectual embargo on Communism or in insulating our young people from the ideological conflicts of the day, but rather in diligently demonstrating, day in and day out, our deep and abiding faith in our free society and in its capacity for self-improvement. As Winston Churchill said at the Mid-Century Convocation, "If . . . there is to be a war of nerves let us make sure our nerves are strong and are fortified by the deepest convictions of our hearts. If we persevere steadfastly together, and allow no appeasement of tyranny and wrongdoing in any form, it may not be our nerve or the structure of our civilization which will break and peace may yet be preserved."

And so I would say to you that the world into which you graduate today is no place for fearsome and frustrated men. It is a place for men who are ready to meet unflinchingly the shock waves that accompany a cold war, men who are tough-minded and stouthearted be-

(*Concluded on page 594*)

THROUGH THE YEARS
Details NOT *Fundamentals* CHANGE



Through the years the powers of fire and explosion have lost none of their destructive and far-reaching effects. Only the knowledge of how to hold these gigantic forces at bay has changed with the passing of time.

Fire and steam are among man's most useful servants, but only in direct proportion to the effectiveness of his accident prevention abilities and loss control techniques.

Primary among our means of control has been the development of an inspection service and insurance system which attacks losses before they occur, minimizing their probability and compensating for their effects.

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DOING THE IMPOSSIBLE

(*Concluded from page 592*)

cause they are fortified by their deepest convictions.

Neither is it a place for men who are hamstrung by cynicism, that jaded sense of indifference which restricts so many people. If you have a sense of adventure, you have the best safeguard against cynicism. Other safeguards are an open mind, a sense of purpose, that feeling of responsibility to society as a prime requisite of a professional man, and, finally, a sense of the importance of our day-by-day activities.

In one of his novels, James Gould Cozzens has a character named Judge Coates, who delivers an opinion on cynicism to a young man named Abner. This is what he said:

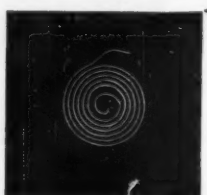
"Don't be cynical. A cynic is just a man who found out when he was about ten that there wasn't any Santa Claus, and he's still upset. Yes, there'll be more wars; . . . I don't doubt. There always have been. There'll be deaths and disappointments and failures. When they come, you meet them. Nobody promises you a good time or an easy time. I don't know who it was who said when we think of the past we regret and when we think of the future we fear. And with reason. But no bets are off. There is the present to think of, and as long as you live there always will be. In the present, every day is a miracle. The world gets up in the morning and is fed and goes to work, and in the evening it comes home and is fed again and perhaps has a little amusement and goes to sleep. To make that possible, so much has to be done by so many people that, on the face of it, it is impossible. Well, every day we do it; and every day . . . we're going to have to go on doing it as well as we can."

When Judge Coates finished, young Abner asked, "What do you want of me?"

"We just want you to do the impossible," Judge Coates said.

And so I would say to the Class of 1949, we just want you to do the impossible. If you can acquire this stabilizing sense of the importance of everyday duties, then you can tackle the troubled world, not with fear but with an abiding faith in the importance of life. If to this you can add the spirit of adventure, then you have the ingredients for a life, not of low prudence but of high accomplishment and enduring satisfactions.

In bidding you Godspeed, this is the kind of life I hope for each of you, as you explore the exciting world beyond the transonic barrier.



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AO SPENCER

HIGH TIDE OF CONFIDENCE

(*Continued from page 561*)

"Shafting and its Fittings"; and "Paper Mills and Machinery." The list of drawings of this Department was comprehensive and treated such topics as marine and stationary boilers, the Harris Corliss engine, marine and pumping engines, cranes, presses, water motors, turbines and breast wheels, screw propellers, machine tools, steam hammers, derricks, and various types of gears. The list included 413 drawings and tracings.

Two theses were shown for the Department of Architecture: "A Railroad Station upon a Bridge"; and a "Reservoir and Waterworks in a Park." In this Department's exhibit the 77 drawings in 60 frames included several copies from the *École des Beaux-Arts;* a porch campanile, a billiard room, boathouse, and a farm barn.

The six theses in Mining and Metallurgy were titled: "The Newburyport Silver Lead Mine"; "The Richmond Blast Furnace"; "The Vershire Vermont Copper Mine and Ore"; "The Port Henry Iron Foundry"; "The Metallurgical Treatment of an Argentiferous Galena, from Burleigh Tunnel, Colorado"; and "The Pomeroy Ironworks, West Stockbridge, Mass." There were sketches of the mining and the metallurgical laboratories; an exhibit of a novel ore dresser, and another of the mining machinery at M.I.T., with samples of products in both cases also included in this exhibit.

The theses exhibited by the Department of Chemistry were entitled: "Anthracene, a Coal Tar Product"; "The Action of Chloride of Sulphur upon Spirits of Turpentine"; "The Action of Tungstic Acid upon Gelatin"; "A Practical Estimation of the Value of Tanning Materials"; and "The Determination of Oxygen in Organic Bodies."

Three theses were shown for the Department of Physics: "The Atomic Theory as Applied to Gases, with Some Experiments on the Viscosity of Air"; "New Experiments in Sound"; and "On the Mean Specific Gravity of the Earth." The experiments, inventions, and descriptive data from this Department were impressively presented: Results of experiments made by students on saving heat by different ways of covering steam pipes were treated, and experiments with a spherometer; on polarized light; and on methods of estimating fractions of units were also prominently displayed. A polarimeter, wind vane, balance, mountain stadia, cosine galvanometer, daylight photometer, plane table, and a "cheap and accurate" dividing engine were listed under the heading of "Novelties and Inventions."

From the Department of Natural History there were theses on: "Geology of Eastern Massachusetts"; and a "Catalogue of the Alcidae contained in the Museum of the Boston Society of Natural History, with a Review and Proposed Classification of the Family."

The Department of Science and Literature had three theses: "The Kingdom of Italy"; "The Times of Edward the Third"; and "The British Province of Australia."

(*Continued on page 598*)

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HIGH TIDE OF CONFIDENCE

(*Continued from page 596*)

Theses from the Department of Philosophy were: "Kant's Aesthetic: A Restatement of it, with some Critical Queries"; and "Historical and Logical Relations between Fichte and Kant."

Eight years had elapsed since M.I.T. had sent out its first graduating class in 1868. The earlier sections of this article, which describe exhibits from the wide field of American industry in the Centennial Exposition, may well be compared with those listed in the immediately preceding paragraphs which tell of the manner in which M.I.T. was meeting the demands of the country's advance in the audaciously virile spirit of post-Civil War industrialists. That M.I.T. had become a going concern is apparent. The Alumni of nearly three-quarters of a century since can profitably review the accuracy of the founders as to what constitutes the high datum of academic ideals – how best to instill into the mind of the student the craving for the knowledge of pure science and its practical application. The described theses, drawings, experiments, and inventions are sufficient evidence that M.I.T. students of the Centennial year were on the job. They had absorbed the scientific knowledge and were eager to apply it practically.

We may be sure that no M.I.T. graduate was deceived by the famous Keely motor, a perpetual motion affair which greeted the public two years before the Centennial Exposition, and the fraudulent claims for which kept up for years. Then, as now, a lag existed between the common knowledge of scientists, and the average man's knowledge of scientific principles and their application.

History tells us that the Centennial Exposition of 1876 was the first occasion when all American sections got together to display their products and future aims. East, West, North, and, as far as the trials of the Reconstruction allowed, the South, foregathered, and, as they viewed one and another's accomplishments, experienced a mutual inspiration. America was truly great, not alone in its resources but in the spirit of its people as well. To all of them the Centennial was the ultimate climax of a century of progress. Today when we can review the vastly increased velocity of progress which has since taken place, we realize that the Centennial was merely a landmark, albeit one of portentous significance.

(*Concluded on page 600*)

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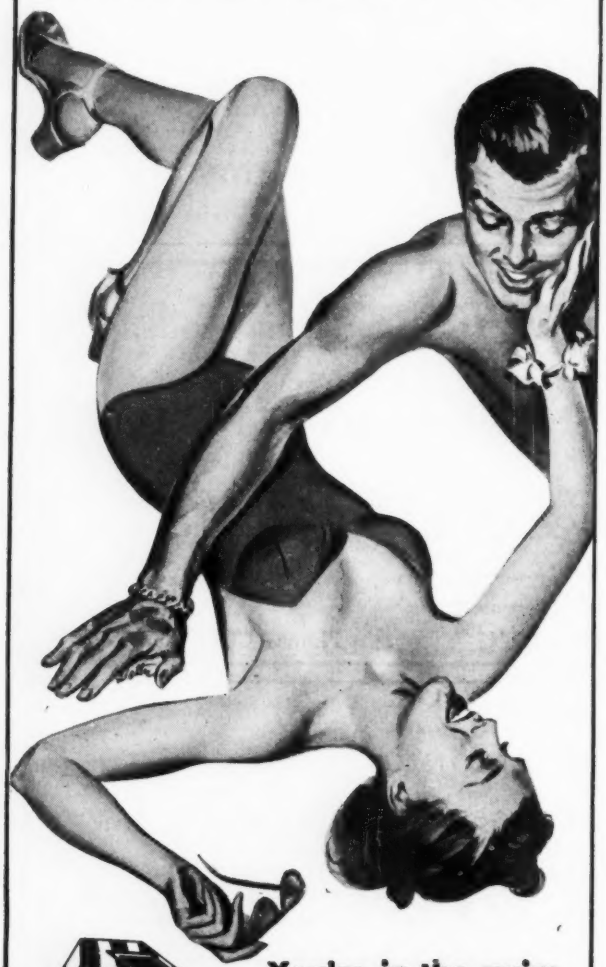

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HIGH TIDE OF CONFIDENCE

(*Concluded from page 598*)

The times were not without men of vision who questioned the *ultimate* future, however. With an ominous note, strangely modern in its tone, young Henry Adams[12] wrote: "I tell you these are great times. Man has mounted science and is now run away with. I firmly believe that before many centuries more, science will be the master of man. The engines he will have invented will be beyond his strength to control. Some day science may have the existence of mankind in its power, and the human race commit suicide by blowing up the world."

More often the prevailing tone, however, was enthusiastically optimistic. In the tiresomely phrased encomiums of the ultraliterate writers of the day, and in the shrewdly practical stories of its great writer, Mark Twain, a common strain predominates. Incredulous surprise would have greeted any doubter of the one point upon which all Americans agreed in 1876. They all believed in the success of the American Democracy, and had faith that a nation "of the people, by the people, for the people" offered greater opportunities for personal feedom[13] than any other form of society which man had been able to devise.

Our grandfathers were alert as they assembled or viewed with shrewd appeciation the 1876 evidences of American enterprise. They exhibited to the full the underlying confidence in the success of American Democracy which all accounts of the Exposition reveal. Would he not be an indignant man of 1876, if by some miracle, he should return to the land of the living, as he would contrast his own high confidence with our present social and political uncertainties which modern science and technology seem to have brought about? Exercising the privilege due to a reincarnated person, would he not strongly advise the man of 1949 to exhibit the very same confidence in one's own nation, and especially in the personal initiative and individual enterprise which marked the Centennial of 1876 as the high tide of American confidence?

[12] Sandburg, *Opus cited.*

[13] In fairness to the present generation, we must realize the great extent of American resources in the year 1876, compared with their greatly depleted present state. In fairness to those of 1876, we must agree that the tools of development of the resources were then greatly inferior. They were contemporary to the candle of President Abraham Lincoln, the runaway horse of President Andrew Johnson. There is food for much modern thought in these realizations, as we of today thumb, albeit a little gingerly, our most potent modern tool: atomic energy.

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THIS RIVER CALLED LIFE

(*Continued from page 562*)

would say in Latin. Holstrom soon found he could discard certain items of his equipment which had no relation to his needs on the journey. By discarding the nonessentials, Holstrom was able to give better attention to those matters of real importance.

Fifth, he found that his rest each night by the side of the river gave him a chance to look up at the stars and catch sight of another world beyond and above his immediate task. This quiet repose at the day's end gave Holstrom the strength and courage he needed.

It seems to me that this story of Holstrom and the Colorado is a parable of the way you and I will best be able to face this river called life from day to day.

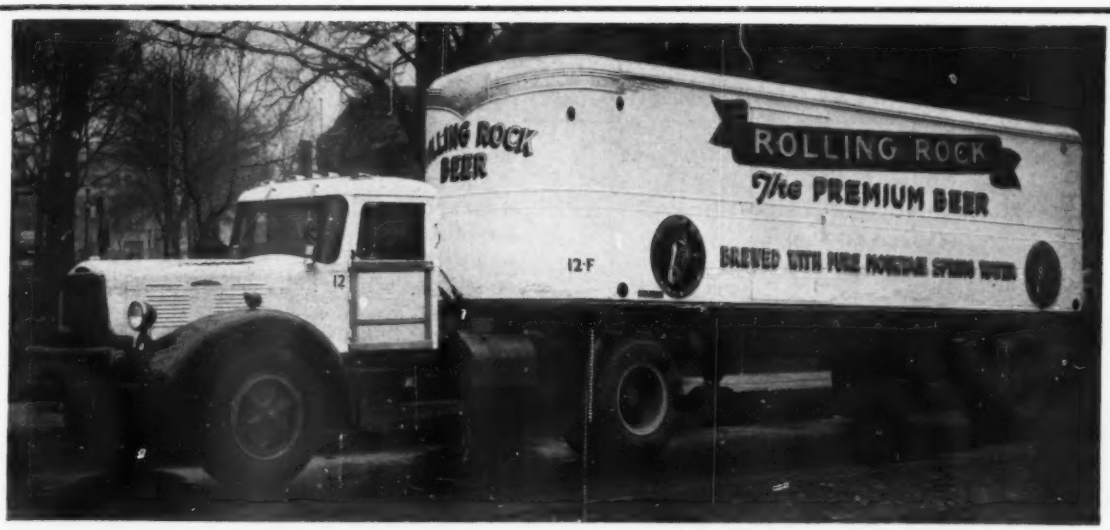
As Holstrom built has own boat to meet his own requirements after studying the strength and weakness of the designs of others, so we shall build our own faith for our travel on the river of life. And here I should like to admonish you on the need for making your own faith and testing it. You will want to study the faiths which others have found useful, and I recommend that you adopt from them whatever you find to have value. In your studies, you will, of course, examine the faiths of your father and grandfathers and you may wish to make their faiths your own. There can be no objection to adopting the faith of another if, upon careful examination and testing, you find it to meet the test of your own needs. But until you make a great conviction your own, an adopted faith is of little use to you, no matter how well it has served others. Whatever your religion, make sure that it is yours by experience and conviction.

As he used and tested his craft in nearby waters, so by doing well the daily work at hand we will find ourselves prepared for our life's great work. Lincoln said, "I will get ready, and my chance will come," and history teaches us how thoroughly he was prepared for the great test of his life. In the small and larger decisions you make every day, you will have the chance to develop skill and character, competence and patience, all of which will make you ready for the great day of decision which every man faces sooner or later.

Perhaps the most important point of all is that we need to know when to go with the prevailing current of opinion and when to go against it. There are two equal dangers here. One is the danger of always going with the current in spineless acquiescence. The other is the danger of being in opposition to almost any good proposal. Neither position is that which a mature person would be expected to take. There are three drifts, at present, we ought to work against.

One is the drift of millions of people to expect "the government" to perform almost all public and personal services for them and for their children. I live in Washington and have good opportunity to see the meeting of those forces which seek to gain from "overhead" many of the privileges and benefits which come at best from individual and group initiative outside of government. We should remember that the government can give nothing to its citizens which our people do not first produce themselves. We must also never lose sight of the fact that to look to others to do for us

(*Concluded on page 604*)



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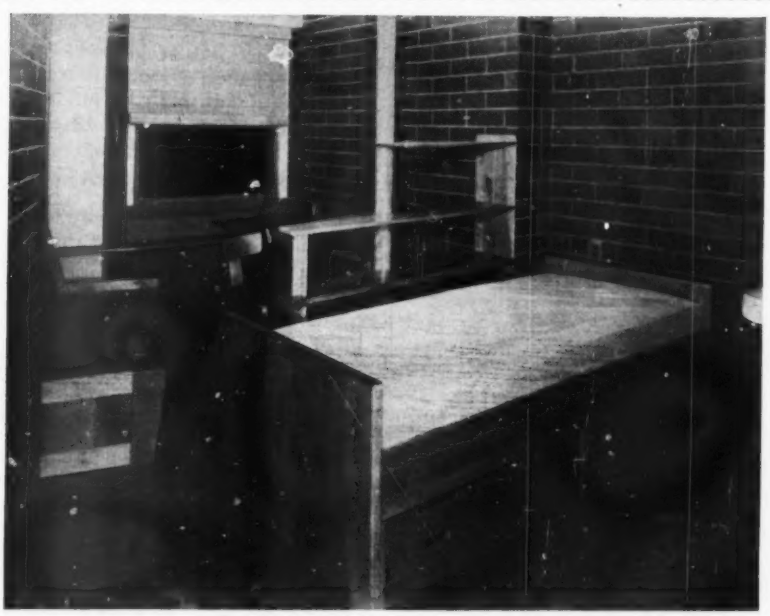

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THIS RIVER CALLED LIFE

(*Concluded from page 602*)

those things which are our own duty and privilege means that we must ultimately rob ourselves of that moral fiber which has made this nation great.

The second drift that I believe needs to be opposed is the apparent drift toward war. Again in Washington I see the almost universal acceptance of the idea that such war is inevitable. This must not be. The common people of every country have everything to lose by war in an atomic age. War must not again happen.

As a third drift to be avoided, I would mention that tendency of labeling liberal-thinking persons as "fellow traveler" merely because their ideas may run counter to the popular stream.

The fourth point of Holstrom's Colorado journey was his elimination of excess baggage. So, too, we must learn what to discard from our minds as nonessential and what deserves our attention. The impact of reading material has multiplied a thousandfold. What not to read is as important as what we do read. Much the same could be said of radio and television programs. Endless stimuli make their impacts upon eye and ear and conscience. Only that spirit which knows what to take, and what to let go, can be adequate to meet the need of modern life.

Finally, we must make room for the lifting of our spirits toward a better world. An awareness of the higher life beyond our immediate experience is as necessary to us on our river of life as it was to Holstrom on the Colorado when he took his night's rest.

Amiel expresses this need of "otherness" when he says, "Let mystery have its place in you; do not be always turning up your whole soil with the plowshare of self-examination, but leave a little fallow corner in your heart ready for any seed the winds may bring, and reserve a nook of shadow for the passing bird; keep a place in your heart for the unexpected guests, an altar for the unknown God."

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CLEVELAND, OHIO

HERE'S THE NEW...

WESTON A-C Clamp-Ammeter and VOLTMETER

5 Current ranges to 1000 Amperes

3 Voltage ranges to 700 Volts

Voltage terminals recessed, with insulated screw-type connectors on leads.

Heavily insulated jaws accommodate conductors to 2" dia. (bare or insulated).

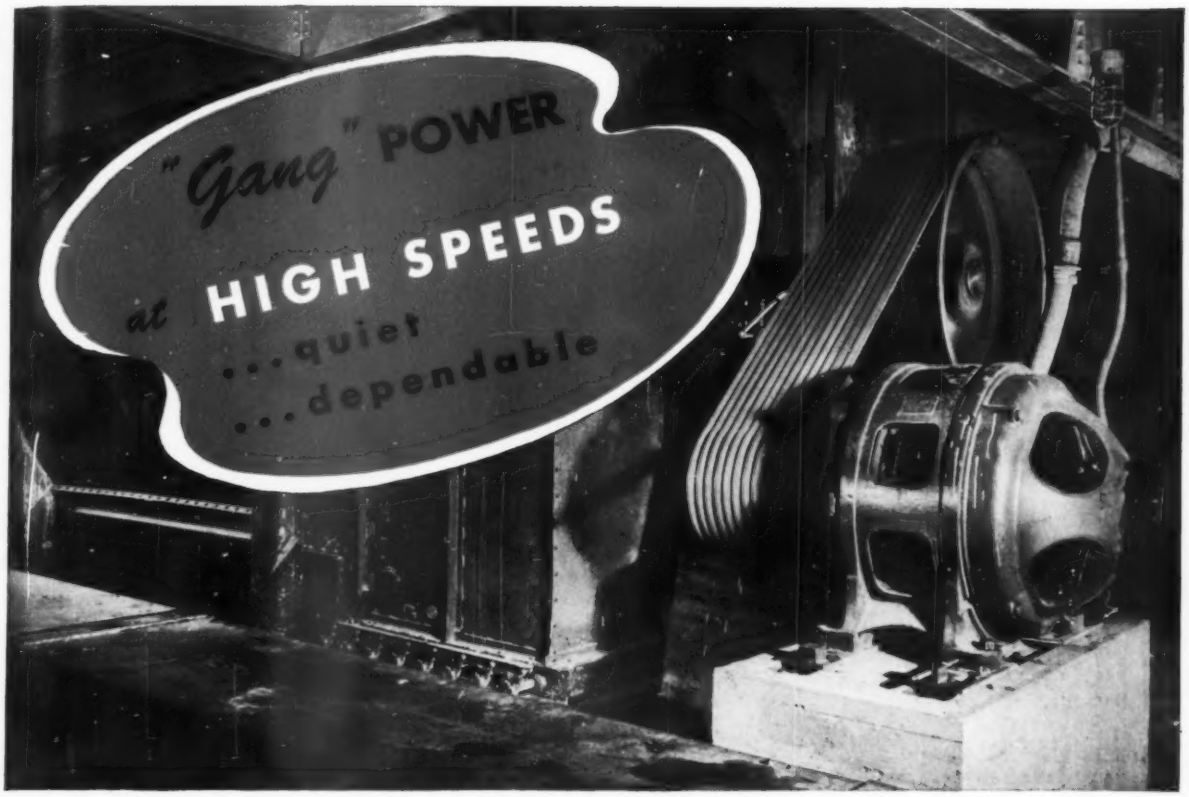
Pointer stop for indicating motor starting currents.

Trigger operation for convenience.

Ask your Weston representative for full particulars, or write... WESTON Electrical Instrument Corp., 702 Frelinghuysen Ave., Newark 5, N. J.

WESTON *Instruments*

Albany • Atlanta • Boston • Buffalo • Charlotte • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Houston • Jacksonville • Knoxville • Little Rock • Los Angeles • Meriden • Minneapolis • Newark New Orleans • New York • Orlando • Philadelphia • Phoenix • Pittsburgh • Rochester • San Francisco • Seattle • St. Louis • Syracuse • Tulsa • In Canada, Northern Electric Co., Ltd., Powerlite Devices, Ltd.



Condor WHIPCORD V-BELTS

Where high speed and constant operation of machinery are vital to a process, you can't beat Condor Whipcord V-Belts.

In malt production, for example, huge blowers must move air at rates up to 200,000 cubic feet per minute —first, cool humidified air during the germinating process—then hot, dry air to dry the malt after germination.

It is on machinery like this that Condor Whipcord V-Belts deliver their best. Despite the terrific test of short center drives at high speeds, Manhattan's *Flexlastics* dissipate heat and permit the Whipcord Strength Members to give longer service.

Also, the *Flexlastic* cushion in a Condor V-Belt seats it firmly in the sheaves to deliver every possible unit of power to the driven shaft.

Whether your drive is two belts or twenty, make sure you get all "pull" for your power costs by using CONDORS.

(Bulletin No. 6868 B describes 8 acknowledged advantages.)

"Flexlastics" is exclusive with Manhattan

RAYBESTOS R M MANHATTAN

RAYBESTOS-MANHATTAN INC.

Keep Ahead with Manhattan

MANHATTAN RUBBER DIVISION **PASSAIC, NEW JERSEY**

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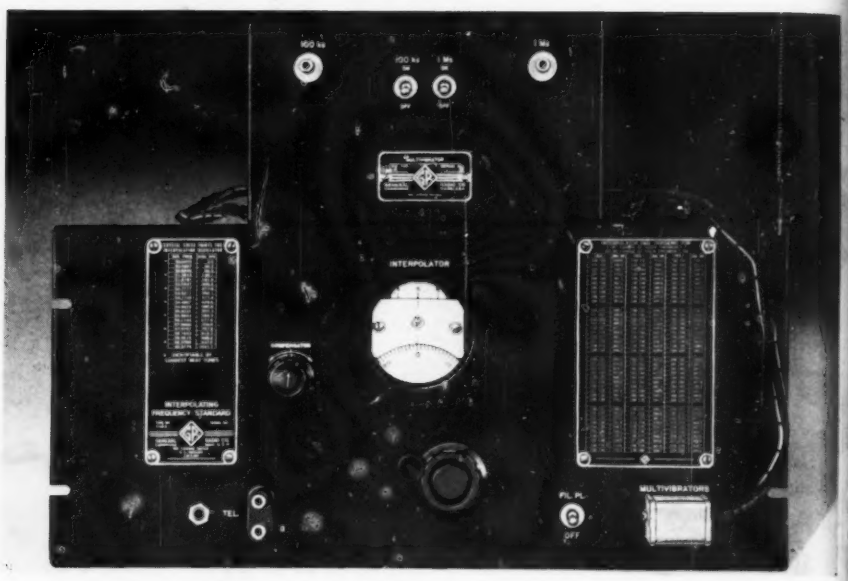


FREQUENCY MEASUREMENTS UP TO 3,000 MC WITH ACCURACY OF ±25 PARTS PER MILLION

•Between 100 and several thousand megacycles, the present accuracy of heterodyne frequency meters ranges between 0.01 and 0.1 per cent. Continually increasing importance of frequencies within this range call for increased accuracy of measurements.

A reference standard and precise interpolation offer the simplest, most inexpensive and most direct method of increasing the accuracy of heterodyne frequency meters.

The Type 1110-A Interpolating Frequency Standard is composed of two units: a frequency standard variable over a range of 1000 to 1010 kc (1%), and a multivibrator unit for frequencies of 1 Mc and 100 kc. The frequency standard consists of a temperature-controlled 950 kc crystal oscillator, a highly-stable 50-60 kc bridge-type variable-frequency L-C oscillator, a modulator and a filter for selecting the sum of the two frequencies at the final output.

When the 100 kc multivibrator is used, the 100th harmonic has a range of 1% as the standard frequency is changed over the full range of the dial, covering 10.0 to 10.1 Mc. The multivibrator harmonics give complete frequency coverage from 100 Mc upward for the 1 Mc unit, and from 10 Mc upward for the 100 kc unit.

FEATURES

ACCURACY OF MEASUREMENT: over-all accuracy is ±25 parts per million using oscillator dial directly. If oscillator is carefully trimmed in terms of the crystal, the over-all accuracy is limited principally by the error of the crystal, or about ±10 parts per million at room temperatures.

SIMPLE TO CHECK ABSOLUTE ACCURACY: harmonics of multivibrators fall at all WWV standard frequencies. With suitable receiver the absolute accuracy, including that of the 950-kc crystal, may be checked readily.

ZERO BEAT ADJUSTMENTS: no need for wide-band circuits or wide-band interpolating methods.

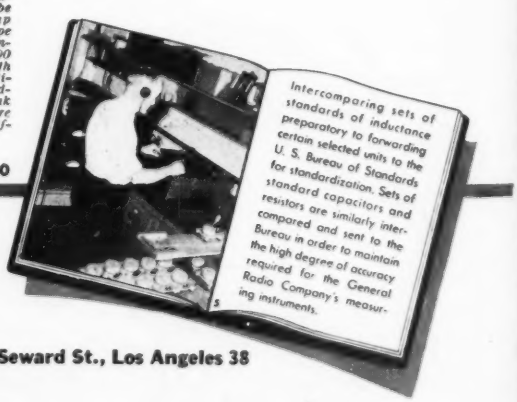
The Type 1110-A Interpolating Frequency Standard can be used for frequency measurements with high-frequency receivers provided the receiver calibrations can identify frequencies if separated by as little as 1 per cent.

TYPE 1110-A INTERPOLATING FREQUENCY STANDARD..... $725.00

TYPE 720-A HETERODYNE FREQUENCY METER

As a companion to the Type 1110-A instrument, this heterodyne frequency meter will be found to be particularly useful at frequencies up to at least 3000 Mc. It employs a butterfly-type tuning circuit, the oscillator frequency being continuously adjustable and direct-reading, from 100 to 200 Mc. A silicon crystal detector is used, with a 3-stage audio amplifier. The output of the amplifier operates a panel meter and a built in loud-speaker. For head-telephone detection of weak signals, a jack is provided on the panel. The entire unit is battery-operated and completely self-contained.

TYPE 720-A HETERODYNE FREQUENCY METER.....$360.00


Intercomparing sets of standards of inductance preparatory to forwarding certain selected units to the U. S. Bureau of Standards for standardization. Sets of standard capacitors and resistors are similarly intercompared and sent to the Bureau in order to maintain the high degree of accuracy required for the General Radio Company's measuring instruments.

GR

GENERAL RADIO COMPANY

Cambridge 39, Massachusetts

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